Wrought-Iron Girders.

There is no distinction in principle between what is known as "plate," "Warren," "lattice," or any other kind of girder, and it is probable that a wider application of the views here brought forward would tend to simplify many obscure investigations. 2. If the flanges of a beam be constructed to carry a uniformly distributed load, they will also carry half the same load concentrated at any point of the beam, and either load passing over it. 3. The main strain in the flanges of a beam is practically the same, whether it has plate or diagonally-braced sides, providing these are properly proportioned; and the one-ninth additional area recommended by Sir W. Fairbairn for lattice beams is unwarranted by theory or experiment. 4. The strain in any point of the flanges of a uniformly loaded beam is obtained by multiplying together the load and sections of the beam on each side of the point selected, and dividing by twice the product of the length into the depth. Corollary.—To obtain the strain in the center, therefore, multiply the distributed load into the span and divide by eight times the depth. 5. The sides of plate beams may be regarded as diagonal bracing, filling the entire space between the flanges, and their proportions may be calculated accordingly through the size and number of stiffening pieces required to keep the plates in shape are, as far as I am aware, beyond the reach of calculation. 6. The strains in diagonal beams of any kind may be made out with ease and accuracy, but no general formula can be given, because the nature of the load and the arrangement of the braces on which it depends may be varied infinitely. 7. For uniform passing loads, however, it may generally be said that the strains are greater at the ends and least in the center; that some of the bars may, during the transit of a load, be under compression and tension alternately. 8. The weight of beam should not be neglected in computing its strength.—*William Anderson.*

Maxims for Masons.

All masonry ought to depend upon gravity, for stability. Rustics, rough faces, rockwork and other analogous forms of masonry are not necessarily any stronger because of the mass on the face beyond the bed-bearing lines. Acute angles, either in beds or in joints, are not allowable. Any angle more acute than a right angle tends to weakness. Bent beds in arch stones, or in masonry generally, must be weak. Mitre joint are not legitimate masonry —all mouldings must be returned. The mouldings will mitre the bed or the joint square. Weight over spaces tends to weakness. Pyramidal-formed arches are objectionable. Ashlar should have harmonious proportions. On face 1, 3, 5 on bed never less than the depth of the face, and square full to the back of the ashlar; slab veneering is false masonry. Arch stones should have a just proportion to the openings, and to the ashlar generally in which they are set. Projecting stones bearing weight on acute angles are weak, and this mode of construction is false in masonry. The springing line in arches must be the line of greatest strength. Pyramids do not stand on their apex. Combinations of rustic and moulded masonry are incompatible with strength or with beauty. Singlestone architraves, mullions and groins are a cause of weakness. The bedding of the courses should be carried throughout. Single-stone columns are weak, especially those of lamina sandstones or of limestone. Built columns, like those of the Madeleine in Paris, are better masonry. Sham jointing should never be resorted to. Mouldings ought to accord with the stone in which they are cut. Classic mouldings cannot be cut in sandstones so as to show and endure. Buildings constructed out of the stones of a district are most in keeping with the landscape. Ashlar-faced walls should not be backed with brickwork or with rubble, without precautions to prevent shrinking or separation of the parts. Deep quoins and their courses produce weak work, especially in towers and in spires. Notched and broken-coursed masonry is only allowable where the stone of the district is unsuitable for a more regular form of masonry. To spoil good stone for the sake of such imitation is false in masonry and extravagant in architecture. Put every stone to its best use in the best form and not in the worst form. Horizontal openings cannot be spanned with vertical jointed masonry: columns, architraves, and piers must be covered with single stones or with an arch; joggles, dowels, and cramps cannot make such work good masonry. All building stones having an aqueous formation, such as stratified sandstones and limestones, should rest on their natural beds. Combinations of brickwork and stones for facework are allowable under certain conditions. Perfect courses of bricks may alternate with courses of stone. Combinations of various sorts of stone are allowable. Perfect courses of stone may alternate in variety.—*Sir R. Rawlinson.*

Durability of Cross-Tie Timber.

In an investigation of this subject made by F. B. Hough for the department of agriculture, some interesting facts are brought out. The relative importance of the various kinds of timber for railroad purposes are reported in the following order: Oaks, pines, chestnut, hemlock, cedars, tamarack, cypress, elms, ash, cherry, black, walnut, firs, spruce, beech, locust, redwood, maple, butternut, coffeenut, mulberry and mesquit.

The average durability of oak, as reported in 32 cases, is 7.4 years, while the average price of each cross-tie is 41.2 cents. The kind of oak is not specified. For white oak the average durability in 152 reported cases is 7.3 years, and the average price in 173 cases is 40.6 cents. The average duration of a post oak tie is 7 years, and average price 33 cents. For burr oak, durability, 7.4 years; price 37.3 cents. Rock oak showed an average durability in 18 cases of 7 years; price 42 cents. In the case of red oak 5 years is the average durability, with an average cost of 27 cents. Chestnut oak is more durable, showing an average lifetime as a tie of 7.1 years; cost, 28 cents per tie. Black oak shows an average durability of 4½ years; average price, 43 cents.

Long leaf or southern pine will last on an average 6½ years; average cost per tie, 37 cents. White pine has about the same durability with less cost, the latter showing an average cost of 31½ cents.

Cedar shows the greatest average durability being 11.8 years, with an average cost of 34 cents, but it is too soft to bear heavy freightage and for that reason is not much employed in railroad construction. Red cedar is more durable than white cedar, being in the proportion of 11 to 7. Cypress shows greater durability than white oak, the former showing an average of 8.7 years. White ash and black ash rot very quickly, the former in 4.3 years, and the latter in 3.8 years. Cherry is a durable timber when used as cross-ties, running from six to ten years. All woods are much more lasting when hewn than when sawn.

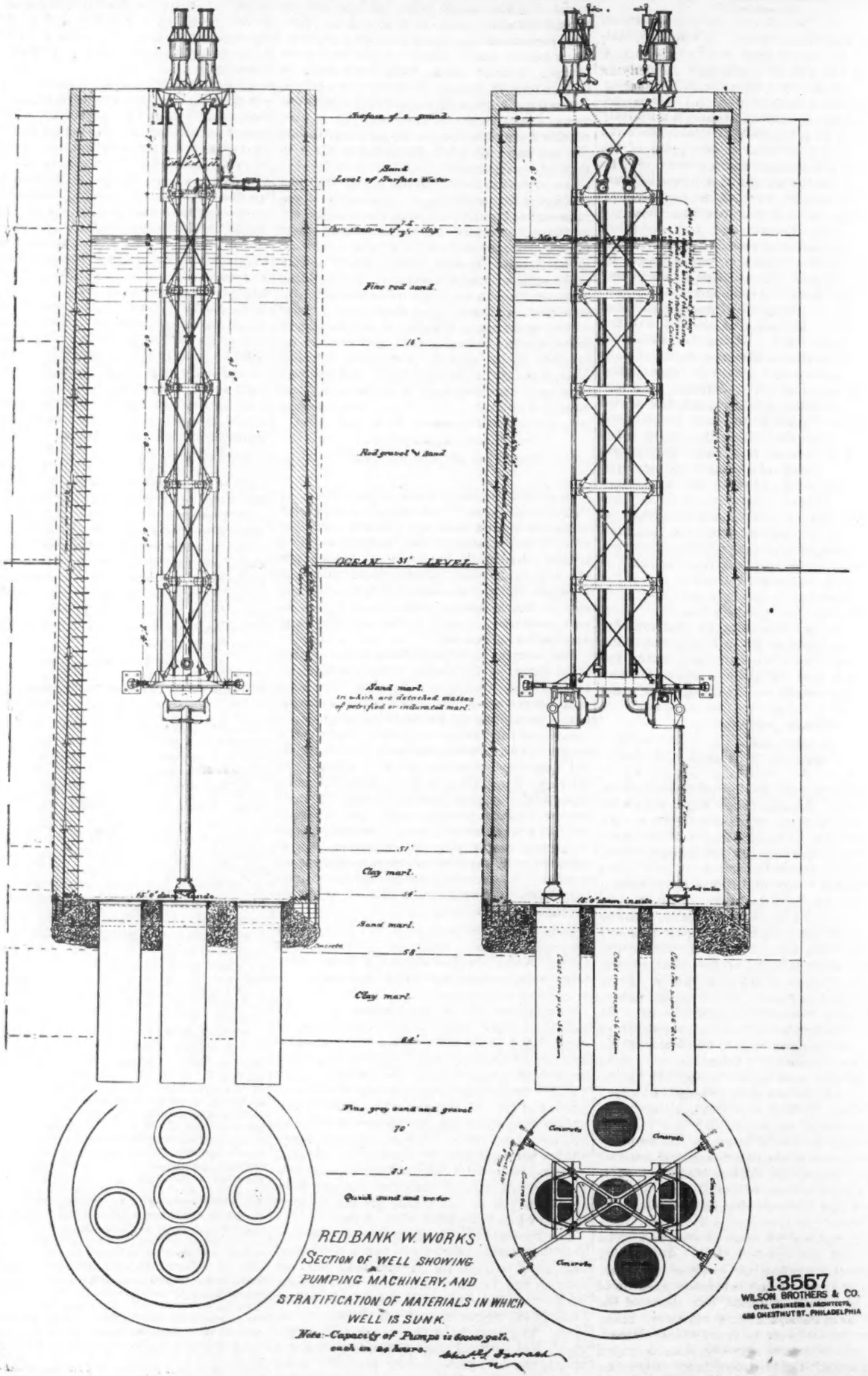
The redwood of California makes very durable ties, lasting over eleven years, but allowance must be made for the fact that they are used on the Pacific roads, in a dry climate, where the causes inducing decay are not so great in the States east of the Rocky mountains. The growth of the red wood is very slow. Trees fifteen years old have a diameter of only ten or twelve inches and will make about three ties, When younger than this the wood is not durable. The redwood of the Santa Cruz mountains furnishes the best ties, it being much heavier and denser than when grown north, The average cost of redwood ties is 40 cents. The total length of railroad track in the United States is approximately 150,000 miles.

Assume that the average durability of ties is seven years and the distance apart is three feet, there will be 2.640 to the mile, which is rather under than over the actual number employed, making the total number in use 396,000,000. Estimating one-seventh to be replaced every year, the annual demand to keep up the present railroads will reach 56,571,428. Supposing than an acre will supply 100 ties, which is a liberal estimate, it will require 565,714 acres annually to furnish the ties required by the existing lines of railroads. For each line of railroad there will be an annual demand for 377 ties, requiring the cutting off of 3.77 acres. It will require thirty years on an average for trees to grow large enough for making cross-ties. The acres that must be kept in timber and growing will be 16,971,420 for supplying ties to the railroad lines now in existence.

To increase in railway mileage, estimated by two decades, is about 4,150 miles annually. To construct the railroads that will probably be built in the next ten years 109,560,000 ties will be demanded, the product of 1,095,600 acres of woodland. Allowing thirty years as the period of growth for ties, this would add 3,286,801 acres to the timber reserve for railroads alone, making a total of 18,996,570 acres as the needful reserve. Evidently this question is one demanding reach of statesmanship and a careful preservation of our present timber supply. The time is not far distant when one of the largest items in the construction expenses of our railways will be the one for cross ties.—*Exchange.*

Ordnance Specification for Carpenter's Work.

1. The timber, deals, plank, and wood of every description to be sound, thoroughly seasoned, free from large or loose knots, shakes, wanes or other defects, and with the exception of timber in the log, and ash, elm and beech plank, to be entirely free from sap, with all sawed sides die square, or sharp angles. 2. Oak plank and boards to be sawn with straight and square edges. 3. The net lengths, breadths, thicknesses, and girths ordered, to be supplied, and, and no allowance to be made for any dimensions beyond those demanded. 4. The oak to be of English or Irish growth, excepting when African oak is especially ordered, and, when in scantling, to be sawn die square or with sharp angles. 5. The African oak to be No. 1 or No. 2 quality. 6. The fir timber to be from Memel, Riga, or Dantzic, as may be ordered. 7. The deals, excepting when ordered to the contrary, are to be yellow Christiana, to be supplied in such lengths and such breadths as shall be directed. 8. In all articles consisting partly of straight and partly of curved work, the separation in the measurement and value is to be made precisely at the springing or commencement of the curve, taking each description nett, except in sashes and frames. The same method is to be observed in dividing curved parts from such as are wreathed, groined from straight parts of centering or cradling, etc. 9. No extra charge is to be made for articles of furniture, but to be paid for at the prices set down in the price list. 10. The lengths of all scantlings in lineal measured work, or reduced to cubic measure, to be taken in at the extreme points, including tenons. For all superficial measurements the tenons are to be included in the price of the superficial quantity when put together and fixed complete. 11. One-eighth of an inch to be allowed on the several denominated thicknesses of superficial measured work, if wrought both sides, viz: for 1 inch it must measure ⅛ of an inch; for 1½ inches it must measure 1⅛ inch and so on for various thicknesses; but, if planed only on one side, it must measure full ⅛ or 1⅛, as the case may be.



RED BANK W. WORKS
SECTION OF WELL SHOWING PUMPING MACHINERY, AND STRATIFICATION OF MATERIALS IN WHICH WELL IS SUNK.
Note:-Capacity of Pumps is 6000 gals. each in 24 hours.

13567
WILSON BROTHERS & CO.
CIVIL ENGINEERS & ARCHITECTS,
628 CHESTNUT ST., PHILADELPHIA

Red Bank Water Works Well and Pumping Machinery.

The water supplied to the town of Red Bank, Monmouth County, N. J., is obtained from the stratum of quicksand underlying the lower marl bed, which, at Red Bank, is 52 feet below the level of mean tide in the Atlantic ocean, and 73 feet below the natural surface of the ground. Prof. Geo. H. Cook, State Geologist of New Jersey, gives a full description of this water bearing strata, in his annual reports for the years 1882, 1883 and 1884.

A line drawn from Fort Delaware to Sandy Hook marks the outcrop of the water bearing sands under the lower marl bed, the dip of the stratification being from 20 feet to 35 feet to the south east. The water is remarkably pure and soft, and may be classed among the best drinking water of the country.

After experimenting on the flow from three artesian wells, driven near the site of the proposed pumping station, it was determined to sink a well 15 feet in diameter on a curb in the usual way (as shown on the drawing.) The flow of water obtained at a depth of 54 feet from the surface, has been found to be between 250,000 to 270,000 U. S. gallons in 24 hours. To elevate this water from the bottom of the well to the reservoir, a height of 169 feet, special vertical compound duplex pumps were designed and built by H. R. Worthington, of New York.

The machinery is in duplicate, each pair of pumps having a capacity of 600,000 in 24 hours, of the following dimensions:

High pressure steam cylinders,	10 inches diameter.
Low " " "	16 " "
Water plungers	10¼ " "
Length of stroke	10 "

The intermediate iron trestle, between the steam cradles and the pumps, as well as the long piston rods, were built and erected by the Wharton R. R. Switch Co., from the following specification and the working drawings:

GENERAL DESCRIPTION.

The iron trestle for the two vertical compound duplex pumping engines for the town of Red Bank, Monmouth County, N. J., is constructed of wrought and cast-iron. The structure is divided into six bays, and is 41 feet 8 inches long, measured between the planed surfaces of the upper and lower castings; to which is bolted the steam cradles and the pump cylinders respectively.

The trestle is suspended from four channel irons, each 15 inches deep, weighing 148 pounds to the yard. These channels, built in pairs, span the well and are supported on the brick lining; they are bolted to and rest upon iron wall plates, which are laid on a bed of cement, bedded in sulphur and securely fastened to the wall by the bolts, which are built into the wall and fastened to the oak curb at the bottom. The top casting rests upon the channel irons: through and from it are suspended, four wrought-iron rods of 2 inches diameter, extending through the whole structure and spaced in a rectangle exactly 6 feet by 3 feet 10 inches. These rods sustain the entire weight of the structure, the force mains in the well and the load on the pumps.

The upper and lower castings, or bed plates, and the five intermediate castings (which divide the trestle into bays) are provided with bosses, through which the suspension rods pass.

The intermediate castings are spaced 6 feet, 9 inches apart, between centers. The struts which separate the castings are made of three inch wrought-iron lap welded pipe (through which the suspension rods pass,) the end of these struts are turned to fit bored holes in the bosses and abut against turned surfaces.

DIAGONAL BRACING.

The structure is braced on all four sides by ¾ inch square rods, connected to the castings with clevises.

The four piston rods are each 39 feet long, made of 2½ inch wrought-iron lap welded pipe; brass sheathings ½ inch thick and 18 inches long, are sweated on to the piston rods at the bearings in the guide boxes. The ends of the piston rods are strengthed, bored to a taper to fit the stems of the piston rods of the steam and water ends, slotted for and provided with keys.

The piston rods are guided at each of the intermediate castings with adjustable boxes having brass bearings.

The structure was erected, lined up, the machinery set and the pumps started successfully without a mishap or single alteration.

At the present time the pumps are run six or seven hours a day. The well, if not pumped, fills with water to within 8 to 10 feet of the surface of the ground, providing a reservoir from which to pump a larger quantity than the flow of the well at the bottom.

This work was designed by and executed under the direction of Charles G. Darrach, M. Am. Soc. C. E., and Hydraulic Engineer for Wilson Bro's. & Co., Civil Engineers and Architects, 435 Chestnut street, Philadelphia, Penna.

Engineering as a Profession.*

BY WILLIAM KENT, M. E., Stevens '76, Pres. of the Assoc.

A recent writer on Political Economy says: "The tournament of the world has changed its fields and its weapons. Men no longer strive with lance for a lady's favors. They struggle with matter to change its forms and add to its value. He who can render industry more varied, or more efficient, who can turn any element or gift of nature to novel use, is the winner of the prize." The same writer says further: "Society will not dispense with professional men, although they do not stand so far above the level as in generations ago. We will call upon lawyers when we get into strife over property and they are necessary to the social structure which protects the person. While sickness comes, doctors will maintain their calling. So long as there is a soul that longs for immortality, clergymen will be welcome in home and pulpit. But with expanding industries, with developing science, new professions have gained favor. Commerce has its spheres in which high training and strong intellects are needed and are well rewarded. So has the varied mechanism of this age. In the professions hundreds are starving in this country in the foolish pride of a decayed caste. In the walks of production, wealth invites every man who will bring brains and industry, which will win skill."

It is of one of these new professions, engineering, that I would speak, and I claim for it a rank as a learned profession equal to that of law or medicine, and second only to that of divinity.

Such a claim, for engineering to rank as a learned profession, worthy of all the honors that have been paid to the older professions, may seem to you, who are students or practitioners in that profession, as an unnecessary statement of a truism—one which needs no proof—you already accept it as almost an axiom. But it is not thus accepted by the world at large. In a recent conversation with a lawyer on this subject, he held that it was impossible that engineering could be of equal rank with the three learned professions of the olden time, since all its work tended only to the material advancement of the race; it benefited civilization only by the increase of wealth which it brought; it was of the earth earthy; in fact, a servant of Mammon; while the other professions were on a higher plane, preserving the life and the morals, and dealing with the intellect and with the immortal part of man. So Charles Dudley Warner, in the *North American Review* for Sept., '84, writes of the "Demand of the Industrial Spirit" (of which spirit we must admit that the engineering profession is the hand-maiden) as denying the higher wants of the soul, as "demanding a radical revision of the college curriculum and that the ancient stamp of scholarship shall be put upon industrial and commercial pursuits." He says, "The last demand of the industrial spirit is that all education shall be lowered to its material aims; for lowered it will be, if all distinction is removed in academic honor between an education for the sake of the mind itself and an education dependent on and limited to material and practical aims. The danger in this is no less to science than to literature and philosophy. It is the greatest to all to the tone of modern life."

Such criticisms as these of the modern tendency of educational methods to fit men for the practical duties of life, make it necessary for us to be able to give a reason for our belief that such a tendency is not a degrading one, and that one of the results of such a tendency, that of placing engineering on the high plane of a learned profession, is not a danger to the tone of modern life, but one of its best safeguards, and is a real and important step in the advancement of civilization.

Let us first consider the requirements of the three professions which have hitherto appropriated the distinction "learned," and compare them with the requirements of the profession of engineering. But first we notice that the requirements of the three older professions are not now the same as they formerly were, but are becoming broader and more severe as the general public becomes better educated. In olden times, it might be sufficient for a lawyer to own a few books, to have a knowledge of the forms of law, and to have the ability to browbeat a witness and befog the judge; the doctor needed to be expert with the lance and with the leech, to have a wise expression of countenance like that of the owl, and be faithful in adherence to tradition regardless of the consequence; the minister should be a man of lordly mien, to be able to exercise proper authority and command the respect of his parishoners, and to have the grace of charity and general kindliness of manner, so as to make him always a welcome guest in their homes. In modern times, however, the requirements have greatly expanded. It is necessary for a lawyer in counsel, to have such intelligence and such honesty, as will enable him to advise a client when to avoid as well as when to seek litigation; in advocacy, to have all the powers given by a thorough knowledge of logic and rhetoric, the quickness of perception, the eloquence and the profound knowledge of the law, which are needed in combat against similar powers arraved on the other side. In medicine, a doctor must know when to withhold as well as when to give medicine, how to save a leg as well as how to take one off, and he must keep familiar with all the most recent discoveries of medical science, and know how to make proper application of them. In divinity the minister must keep abreast of his flock in intelligence; must be well versed in history, literature and science, as well as theology, to enable him to meet every new argument against his own beliefs which may be drawn from any branch of human knowledge. These three professions now all ask for the most liberal general culture, including not only a classical education, but a knowledge of the universe of learning, of all that is known or to be known of nature and humanity.

Let us compare these requirements with those of an engineer who should rank as a member of a learned profession. He should be a man of broad general culture. No branch of education should be looked on by him with contempt, and his culture should be a broader

*An Address to the Alumni Association of the Stevens Institute of Technology—June 18, 1885.

one than that given by the old college curriculum. The "demand of the industrial spirit" is a noble one. It is for a higher and broader education than that of Oxford and Cambridge. All the culture that the Greek and Latin tongues may give, all that history, literature, music and the fine arts may give must not be slighted. Do the classics give a man stronger reasoning powers? Does literature give him the graces of speech and the power of the pen to mold human thought? Do the fine arts give him the sense of the beautiful? All these are of benefit to the engineer; but to these he must add as more important to his professional success the knowledge of human nature and of finance, gained only in the school of business experience; and of the higher mathematics, which he must use as easily as a mechanic does his two-foot rule; of the sciences which reveal to us the secrets of nature, geology, mineralogy, physics, chemistry, and their allies; and to all these he must add a sound body with a sound mind, a familiarity with the powers and the limitations of the mechanical trades, and a certain amount of personal manual dexterity.

So vast, indeed, is the field of knowledge which the profession of engineering requires as its foundation, that no one man can be expected to encompass the whole of it. As the jack-of-all-trades is generally master of none, so the engineer who attempts to become educated in all branches of even the ground work of an engineering education, not to speak of the branches of the profession itself, is apt to prove a failure. Hence the necessity not only of specializing the profession of engineering into the branches of military, naval, civil, mechanical, mining, electrical, sanitary, and the like, but also of making a discrimination as to the branches of general education which should be acquired as preliminary to an entrance into the general study of engineering, and of its special branches. Hence the specializing of schools of engineering, Rensselaer devoting itself chiefly to civil engineering, Columbia to mining, Stevens to mechanical engineering.

I may here mention the place which such professional schools should occupy in our general American educational system. Vice-Chancellor McCracken, of the University of the city of New York, said the other day: "The college is a school that teaches something about everything; the university is a collection of schools each of which teaches everything about something." He argues in favor of postponing university work in arts and science until after graduation from college, and says that the only foundation in America that has made its principal business to set up a university faculty in arts and science, the John Hopkins University, enrolls this year 174 graduate students in arts and science, representing 97 colleges. He does not mention technical schools, such as Stevens, in his address, but I think that if he considered the matter he would advise as I would, that the technical school of mechanical engineering be ranked as one of the schools of the university; a school whose place should be to teach everything about something, and that something mechanical engineering, and not to teach something about everything, which is the function of a college. So also a collegiate education should, if possible, be obtained before entrance into the school of engineering, as the best possible preliminary preparation. And here I would agree with Vice-Chancellor McCracken in his argument against inviting sophomores to become specialists. He says: "It is injustice to a boy of seventeen, and the Harvard sophomore is but seventeen. It encourages him to a premature marriage of himself to some 'ology' or 'ism.' * * * How can the youth of seventeen, until he has looked over the whole field of learning, decide as to his turn of mind, whether it is not poetic or philosophic, or a mind for invention or for acquisition, for leading or for following, for the study of the world of things or the world of men."

So much for the requirements of the engineering profession as far as education is concerned. Let us now consider its requirements in actual work.

The work of the engineer has been defined as the overcoming of the resistances of nature, and the best engineer is he who effectually overcomes these resistances with the least expenditure of time, labor and money. The successful engineer must love his work for its own sake, and not for its emoluments. He must have the same professional pride that a good lawyer or doctor has, and be ready to sacrifice his money, fame, or even life itself, if duty should demand it. The responsibility thrown upon an engineer is sometimes one whose extent cannot be measured by a money standard. His mistakes may be more serious than those which hurt only the pockets of the lawyer's client, or those which the doctor buries six feet underground. Think of the mistake of the Ashtabula bridge, the engineer of which committed suicide; of the Tay bridge, the disaster to which is said to have broken the heart of its builder. And as to financial responsibility, how many millions of dollars have been lost by engineering mistakes. See the abandoned mines and mills in our gold and silver districts, the silent blast furnaces and rolling mills built in the wrong locations, the waste of money and of life in the Hudson River tunnel and in the Panama Canal.

No higher trusts are assumed by any other profession than by that of engineering. It behooves that profession, therefore, as much as any other to be sensitive of its honor. Shall a judge be corrupt, or a lawyer defraud his client? No more should an engineer either give or take a bribe, or do aught to bring dishonor on himself, or to demoralize his associates. In manners he should be beyond reproach, but in integrity beyond suspicion.

In its rewards the profession of an engineer is not behind any other. If statistics could be brought to bear I have no doubt that professional engineers could be found, on an average, to be reaping greater financial rewards than the average of doctors, lawyers and ministers of the same number of years in practice. Mr. Roberts, in his "Government Revenue," estimates that of physicians only one-third earn over $2,000 per year, one-fifth earn between $1,000 and $1,500, the next one-fifth will strive for $1,000, and one-fourth will get only $600, $500, or less. Of lawyers he says the annual earnings of less than one-fourth are $2,000 per year, one-tenth in addition receive $1,000 a year. "No calculation can bring the number getting $1,000 a year from their profession to one-half of those on the rolls as in active practice. One-fourth do not earn $500 annually from legal business." I have no doubt that the engineering profession would show a much better record than this if statistics could be obtained.

In the reward of public fame and honor, no profession stands higher than that of the engineer. If a list of the benefactors of mankind since the time of Archimedes should be made, the engineers of the world would be conspicuous in it both in the number of their names and in the grandeur of their achievements,

There is one grand distinction between the professions of law, medicine and divinity, and that of engineering. The former are the professions of conservatism, the latter is the one of progress. The object of the profession of medicine is the conservation of life; that of law, the conservation of morals and the rights of property; that of divinity, the conservation of belief. Engineering, however, is essentially progress. Its history is one of continual advancement. It is like science itself, so far in fact that many of the advancements in civilization greatly credited to science pure and simple, are really the achievements of engineering, an applied science, of which pure science is but the handmaid. In this connection I may quote from Prof. Thurston's paper on the "Mission of Science," and you will note that the word "engineering" might be used wherever he uses the word "science." "A century ago, with the birth of the steam engine, later with the introduction of the product of the printing press into the daily life of the world, with the operation of the electric telegraph, and the introduction of the railroad, began the real progress of science, and we are now seeing but the beginning of her awe-inspiring career. She has taught us to drive ten thousand tons across the seas by the might of over 12,000 horse-power engines. She has taught us to send printed messages across the continent; she has shown us how to drive railroad trains faster than birds can fly, yet the mission of science has made but the veriest beginning. It still remains to her to perfect and systematize a thousand new industries, to invent as yet unimagined new arts, to bring the laborer worthy of his hire all that he needs and all that he can desire for his own comfort, and for the care and comfort of his family, to adjust the power of production to that of consumption, and both to the working capacity of the world, so that the now seeming natural conflict between labor and capital shall no longer have even an appearance of existence."

Probably similar thoughts were in my own mind three years ago when writing from the Electrical Exhibition in London, I mentioned the possibilities of future achievements of one branch of engineering, the electrical, I said: "These currents of electricity shall furnish power to drive our railway cars, our road vehicles, and our steam boats; shall furnish energy to run our sewing machines, to raise our water, to light and warm our houses and cook our food. They shall separate the ore from the dross, shall reduce and refuse the ore into metal, and shall gild and refine not only our metals but our whole civilization. And when this is done—when man has subdued unto himself all the forces of nature and forced them to do his work, will he work any fewer hours or less hard? Will he take any more rest, or any more pleasure, or will he be the same over-worked, nervous, ambitious and dyspeptic creature that he is now? Will electricity solve the labor problem? Ah! these are questions apparently beyond the reach of our present philosophy, but they are questions which the future is bringing to us with terrible rapidity. It is wise to look them in the face."

I have thus given you briefly some of my views on the requirements of the engineering profession, of the work it is called upon to do, and of some of its future possibilities. I hope you see as I do, that the profession is not altogether of the earth earthy, that it is not altogether a profession whose end is simply the increase of wealth of a favored few, but that it is a profession charged with as weighty responsibilities and duties to the human race as any other; that it is the profession to which the world must look for nearly all future advances in civilization, whether these come through the enginery of war, civilizing barbarians by the means of modern artillery, through sanitary engineering, at the same time preserving the health and benefiting the morals of mankind, or through inventions which shall so increase the wealth of the human race at large that the primal curse of labor may be to a great extent removed, and the race have more time than it now has for the cultivation of its intellectual, moral and spiritual nature.

ENGINEERING NEWS Three months for One Dollar.

The Beehive Refuse Destructor.

Since our remarks on the utilization of refuse we have had an opportunity of inspecting a new "Destructor" for refuse called the "Beehive," which has been erected in the vestry yard at Richmond, and is now in operation. To enable us to form our own opinion of the Destructor and the work it accomplishes, a company of gentlemen representing the press was invited to Richmond by the agent for London to inspect the newly-constructed apparatus which occupies a central position in the yard of the Richmond Board of Works. The "Destructor" at present built consists of a lofty brick shaft, 90 feet in height, of Burnley bricks, attached to which on two sides are furnaces in the form of beehives. These domical-roofed furnaces are connected by flues to the chimney shaft, which carries off the smoke and gaseous matter, and creates a draught. A sliding damper at the junction of each with the shaft is introduced. At the time of our inspection, two or three laborers were engaged in throwing the refuse into the openings provided in the domical roof of the beehives. We found nothing at all objectionable in the process, not the slightest odor from the burning being perceptible, while the smoke discharged is light and is perfectly harmless. Each beehive or domed furnace is about 6 feet in diameter, banded with iron at the springing, and composed of fire-bricks made to a mould for every course; it is divided into three parts vertically by two tiers of bars, the lower bars, which are rectangular in section, receive the fuel, and are placed about 1½ inches apart. When the fire is kindled the refuse is thrown through a top opening in the side of dome upon the upper grate composed of bars about 2 inches apart. Here the material, which consists of all kinds of ingredients —rags, ashes, tins, vegetable and animal matters, is quickly deprived of its noxious and dangerous properties, the gases being carried away up the chimney, and the solid materials burnt, or fused into black harmless ashes. Some of the unburnt ashes fall through the upper bars, and become fuel, adding to the speedy destruction of the whole. A sliding iron door closes after the refuse has been thrown in, and the process of destruction can be watched or the material stoked through inspection openings in the dome, or from the furnace doors. Nothing can be more simple or expeditious; all labor in screening is saved. The rubbish is quickly consumed, rendered harmless, and the surveyor informs us that about a ton of coal a week has sufficed to do all the work. The consumption is about 15cwt. per hour, and the cost at Burnley, where the inventor has carried out the process most successfully, is 10d. a load of material.

Th Beehive Refuse Destructor is the invention of Mr. John Ed. Stafford. A. M. I. C. E., borough engineer of Burnley, and we may now give our readers that gentleman's experience of the destructor, which has been constantly at work and stands upon an area of nine or ten square yards. All the most objectionable refuse the town produces, such as offal from slaughter-houses and fishmongers' shops, market sweepings and garbage, street sweepings, refuse from ashpits, middens, etc., is consumed without smell or residue. Human excreta are also dealt with, but must, of course, be mixed with ashes or cinders. Oyster shells leave a calcined residue of 3 per cent. The cost of building one of these destructors is about £70, without the chimney; but after the first cost there is little expense in repairs as the destructor is banded with iron to prevent dislocation of the materials by expansion. At Burnley, the cost of working, including fuel and labor, is stated to be under 1s. per load, though, of course this item will vary in different localities. In the manufacturing towns of the North, the cost of the erection of a chimney shaft can be saved where a chimney of some mill or works exists, as the authorities find it no difficulty in obtaining the sanction of mill proprietors to allow the flue to be connected therewith. A chimney of 30 yards high, or about 90 feet, is found sufficient to carry off all smoke and gas, and the cost of such a shaft at Burnley Mr. Stafford estimates at about £90, or £3 per yard of height. The destructor can be kept at work night and day. Mr. Stafford states that "to effectually destroy all the objectionable matter produced by a town of 70,000 inhabitants three of these destructors would be required, costing a total of £210, or, say, £3 per thousand of the inhabitants, or £30 per 1,000 loads of refuse."

These facts speak for themselves. In the London and southern districts, of course, the cost of fuel is more, and a small additional sum per load may be anticipated, though it is found after first lighting the cost is chiefly one of labor, and the fuel required may be stated to be a ton a week for two destructors such as those at Richmond. To give an idea of the thoroughness of the consumption it is stated that three medical men at Burnley, Dr. Brown, Dr. Mackenzie, and Dr. Briggs tried the experiment of burning a measured ton of ashes and half-a-ton of excreta, which were consumed in an hour and a quarter and rendered perfectly innocuous. One destructor is sufficient for a population of 20,000 people. The Beehive has been in working order at Burnley for some time, and at Bradford and Leicester the destructor is being erected.

We have yet to speak of the product or calcined residuum. The specimen of clinker produced at Richmond, and which we inspected, quite satisfied us that a useful and very saleable product can be turned out more than sufficient to pay for the cost of burning. As a material for the under-layer of roads nothing can be more suitable. The calcined residue is produced in black masses of half-fused material of a porous quality and possessing a metal ring, making an excellent foundation on a clay substratum. If ground up the material would fetch a good price for mortar making, as the large quantity of ashes impart a desirable property to mortar—a fact already well known to builders. It is a question whether it would not pay a good return for capital if a large vestry erected mortar mills upon its premises. The very general complaints made by the inhabitants round Acton and other brick-fields near London, who have to endure the sickening smells arising from the process of clamping, or burning bricks, in which the brick earth is mixed with fuel, or the siftings and soil of ash-bins, are strong reasons why local sanitary authorities should consider this matter in the interests of ratepayers. By collecting the ashes and refuse weekly, and reducing it by burning to an innocuous material suitable either for roads, brick or mortar-making, the evil we have mentioned might be quickly averted, and the health of the community increased. Another and even greater evil would be abated by the use of the destructor—namely, the abolition of the mode so dangerous to health, of making accumulations of refuse in every spare plot of ground or disused gravel-pit, upon which deposits, either old and therefore forgotten, or of recent date, houses are built. The sad results of this pernicious practice we have before detailed, of inmates sickening in confined quarters over fermenting offal, or of being decimated by fevers and epidemics of which the drains are the supposed cause. Of how many thickly-tenanted districts near London are so built we dread to think! The process of slow decomposition takes place, causing settlements and cracks as the gas at the same time is drawn or sucked up into the dwelling. On these grounds, even more than on the ground of public economy, the "Destructor" or cremation system of disposing of the waste of our great towns commends itself to all authorities. The simplicity, efficiency, and cheapness of the process, as illustrated by Mr. Stafford's apparatus, entitle it to a place in the yard of every board of works or local authority. It occupies very little area, and can be multiplied to any desired extent round one chimney, while the product occupies so small a space compared with the raw and offensive material that it possesses important advantages over other destructors of a similar kind. In the mean time we shall await with interest the results of the Richmond experiment.—*Building News.*

Accidents from Fire-damp in Mines and the Means of Preventing Them.*

BY L. PARENT.

On the night of Jan. 14, 1885, an explosion took place in gallery No. 1, in the mines of Lievin, causing the death of 28 workmen. This catastrophe has called renewed attention to the subject of fire-damp, and in the following the author proposes to develop certain new theories, which, if they do not throw full light upon the origin of these accidents, will at least open the field to further discussion of this important subject.

Fire-damp at the Mines of Lievin. The reports of the journals, the declarations of the wounded, and of the workmen generally, being identical, it is permissible to formulate from them the causes of the explosion with great certainty of truth.

The reporters of the journals attribute the accident to the gaseous emanations from the carbon dust, saying that "this gas has been fired by the explosives used in blasting."

The part taken by the dust of coal in accidents from fire-damp has been studied by MM. Mallard and Lechâtelier (1), and this question, which has been rather avoided by the Commission on Fire-damp, does not appear to have been sufficiently elucidated, for the conclusions of these two experts do not accord in several particulars with those of the German commission on fire-damp of 1884. The following are some of the propositions formulated by the two engineers named:

1: An inflammable mixture of dust and air requires, for lighting it, a flame having a certain minimum volume, this minimum varying with the nature of the dust.

2: The size of the grains plays a certain role in the inflammability of the dust; but it is secondary, decreasing with the size of the grains.

3: The dusts of Blanzy are themselves inflammable, for velocities included between 1 and 4 metres; in this proposition, as in the other, the results are negative.

4: Inflammability is in direct proportion to the quantity of oxygen contained in the dust; the temperature at which commences the distillation of the volatile matter, playing also a part in their conductibility.

5: The proportion of dust ought to be very considerable to furnish a combustible mixture. According to Mr. Galloway, 1 kilo (2.2 pounds) to 1 cubic metre (35.3 cubic feet) was required, a condition which Messrs. Mallard and Lechâtelier found nowise exagerated.

These experts then analyse the results of Messrs. Galloway and Abel and compare them with their own, and though there is some difference of opinion they unite with these experimenters in concluding "that in case the dust is in the presence of a combustible mixture of fire-damp and air, this dust plays a double role in augmenting the intensity of the explosion and in increasing the volume, and, as a consequence, the destructive power of the gaseous products. But it is impossible to fix, in any certain manner, the exact proportions."

Mr. Galloway is more exact, and fixes at 0.892 per cent. the quantity of fire-damp neces-

*Translated for ENGINEERING NEWS, from *Le Genie Civil*, August 1 and 8, 1885.

(1) *Annales des Mines*, 1882.

sary and sufficient to determine an explosion in this case.

According to more recent experiments, Messrs. Mallard and Lechâtelier attribute to pure hydrogen great influence upon the speed of transmission of inflammation in explosive gaseous mixtures; the effect appears to be maximum with 10 per cent. of this gas.

As precautions to be taken, these authorities recommend the previous sweeping of the floor of the gallery and the woodwork for a distance of 10 feet from the blast to be made; they have little confidence in the palliating methods tried at present. In no case should the coal dust be used for tamping, and charges too heavy should be avoided. As a final precaution, it will be well to remove the workmen to a greater distance from the blast when the dust is of a very inflammable nature.

"Whatever it may be," concludes Messrs. Mallard and Lechâtelier, "we consider it as established that coal dust in the absence of fire-damp does not constitute a cause of serious danger; it only plays an important part in aggravating the effect of an explosion produced by the gas. The fire-damp, in volume sufficient to cause an explosion, is alone the enemy against which all effort should be directed; the dust holds only a secondary position."

The meteorologic conditions are intimately connected with this dust question. It is of the greatest interest therefore to observe the thermometer during the period preceding the 14th of January, and these observations give almost a prophetic character to the conclusions of Mr. Galloway, made nine years ago. He then said: "The explosions, whose importance is due to the presence of carboniferous dust, happen more frequently in cold weather; and reciprocally, we expect to find that the explosions produced in a cold season are attributable in a certain manner to coal dust."

As we are now in possession of facts emenating from the most competent scientific authorities, we propose to apply and examine them in a general manner in connection with fire-damp; treating the subject as follows:

First, the influence of the blasting charge; second, the influence of the dust; third, the effect of an air current in regard to its quality and quantity, the action of cold and dry seasons and of ozone; fourth, the influence of an air current with regard to the point of origin of the accident, a divided or undivided current, a direct current or one with change of direction, whether the work is preparatory or usual work, etc., and fifth, conclusion and measures to be taken.

I. THE INFLUENCE OF THE BLASTING CHARGE. The deflagration of a certain quantity of powder tamped into a bore-hole determines several effects due to the transformation of the energy stored in the powder. We separate these different forms of energy as fol lows:—

1: *Breaking effect.* This potential form of energy is due to chemical affinities. There is an instantaneous production of a great volume of gas. The relative measure of this instantaneous production of gas gives the value of the explosive itself; and it is to obtain certain breaking effects, that users have been lead to substitute for powder, properly so called, other more energetic explosives, usually termed "breaking powders."

2: *Balistic effects.* This form of energy is represented by the live force impressed upon the projected fragments. Here the motive agent is the expansion of a gaseous mass raised to a high temperature. The cloud of dust raised by the flying fragments may be connected with these same effects by repercussions.

3: *Sonorous, calorific, luminous, or electric effects.* A charge of 100 grammes (3.5 oz.) of mining powder releases 51,000 minute heat particles (calorics) and produces 173 litres (10,553 cubic inches) of gas, of which the temperature, even with the minimum resistance of tamping, can be estimated at 1,800° C.

According to controlling conditions, some one of these effects may predominate, either by being provoked or accidentally produced. For the case now under consideration, it is sought to diminish the last named, and canon-like shots, retamping, hanging fire, etc., ought to be considered as accidents. Among both miners and artillerists the firing of powder with a suppression of the luminious effects has been an end long sought after, but not as yet accomplished with satisfactory results.

We will now analyze these phenomena with reference to the atmosphere of the mine. The gaseous mass, instantaneously produced, must make a place for itself in the ambient atmosphere; like the piston in the cylinder of a gas-motor, it pushes back the air, which flows up and down the gallery from the point of explosion; it forms a stopper of carbonic gas which has little in it to invite combustion. But, if we analyze the phenomenon we see that the compression of the air is rapidly counter-balanced by an influx of air, and this compression is succeeded, no less rapidly, by a relative expansion. In fact it is a wave in which we perceive the ebb and flow. The release of pressure in the air has for its results: First, the loosening and dislodging of fire-damp, held in the cavities in the rock surface made by blasting, and secondly, it strains out and collects the gas. The air precipitates itself to fill the voids resulting from the condensation and contraction of the hot gases, and this movement in the mass also draws out the fire-damp and dilutes it to a point, when it may become explosive; and if in passing outward this mixture meets a flame of any kind a new explosion is produced, which is the accident, properly so-called.

We prefer this explanation to that which attributes the accident directly to the ignition, by the hot gases escaping from a blast, of an explosive mixture supposed to pre-exist in the mine.

As to the results of this combustion and the elevation of the temperature produced by it, we may speak as follows: The combustion of the powder will principally release carbonic acid and azote, some watery vapor and oxide of carbon and a little sulphuric acid. The combustion of marsh gas will give the carbonic gas and watery vapor; but if, in practice, the pyrometric effect due to the combustion of this gas, in the proportion of one per cent. of mixture, should be very much elevated (1,000 to 1,100° C.) by reason of the instantaneous nature of its formation, the escape of caloric ought to be rapid, the chilling action of the confining limits increasing as the cube of the dimensions of the gaseous sphere.

After this come causes of another nature, such as dust. If the mine is humid, and if the accident is produced in a main gallery where the air circulates in great quantities and is uncontaminated, it is safe to conclude that it will not spread to other parts. If, on the contrary, the mine is dry and dusty, then the action of this dust should be considered.

II. THE INFLUENCE OF DUST. The results of the experiments of Mr. Galloway are classified as follows:

1: A mixture of fire-damp and air, in the proportion of one of the first to sixty of the second, does not give any positive indication of the presence of an inflammable gas, when sought for by methods usual with miners.

2: A mixture of one volume of fire-damp with 112 volumes of air becomes inflammable under pressure and at the ordinary temperature when it is charged with fine and dry coal dust.

It seems reasonable to conclude that an explosion, having its origin in some such fashion, in dry and dusty mines, might extend into the more remote parts of the mine where the presence of fire-damp is not even expected.

The shots in the mine being able to raise clouds of dust, we can conceive that the explosion may be communicated to a mixture of air, fire-damp and dust, and propagate itself by the more or less complete combustion of the dust raised anew by air currents. It seems then that the presence of fire-damp should be necessary. Whatever it may be, we will now consider how we may measure the degree of harm to be apprehended from the dust, according to its nature; the degree of division of the particles; the quantity of oxygen it contains and the degree of relative dryness or humidity.

1: Can coal dust, even impure, be ignited by similar particles alone?

"It has been recognized that certain fine powders are inflammable while others are not. It is necessary for this action that the combustible should contain at least thirty per cent. of volatile matter. It is important to note in this connection that mines of lignite, generally very dusty and containing much volatile matter, have not, so far, been the scene of any considerable accident of this nature." (HATTON).

While there is nothing absolutely known, we can safely say that that dust is the most imflammable which is derived from the coal which is the most gaseous and distilled the most readily under a relatively low temperature. In default of the immediate composition of the dust, we have the organic analyses from the memoir of Mr. Galloway. It will be seen that the figure of thirty per cent. of volatile matter is in fact arbitrary.

The following analyses of two kinds of coal dust used in Mr. Galloway's experiments were made for him by Dr. Frankland.

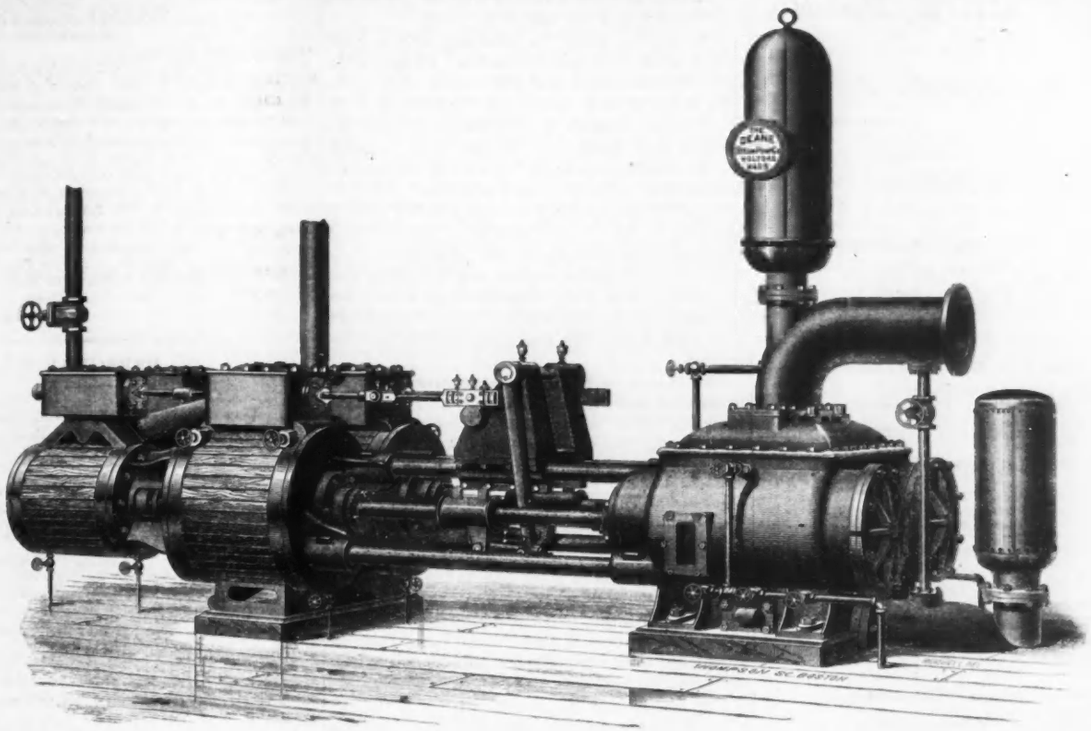
	Steam Coal	Coking Coal.
Carbon	85.295	82.570
Hydrogen	5.046	5.400
Oxygen	1.261	6.030
Azote	0.608	1.050
Sulphur	0.692	0.800
Water, hygrometric.	0.614	0.670
Cinders	6.490	3.480
	100.000	100.000

The results of these experiments seem to indicate in a conclusive manner, that a mixture of air and coal-dust is not inflammable under pressure and at an ordinary temperature.

Nevertheless, as we have already seen, the fact has been directly observed that the hot gases escaping from a blast have a temperature more than sufficient to instantly distill certain fine powders. The crust of coke found on the timbers after a great accident from fire-damp have been analyzed by M. Chausselle, and he found that the coal thus carbonized by the flame of explosion had lost 25 per cent. of the volatile matter it originally contained—about 7 per cent. of the weight of the dust thus carbonized. "Each kilogramme (2.2 lbs.) of this dust had then released 70 grammes (2.45 oz's.) of inflammable gas, almost 100 litres (3.52 cu. feet), considered at the ordinary temperature."

2: The state of division of the dust is directly connected with the mode of circulation of the product of the mine through the galleries; and it is well to distinguish the main galleries from the secondary galleries, which are affluents of the first. The products coming to the hoisting shafts generally circulate inversely in direction with the air current, and the ease with which the dust can fly will be measured by the velocity of the air current itself (coming from the shafts) plus the speed of the car itself. It is evident that if the product circulates in the same direction and with a speed equal to that of the air current, dust would not be raised. The eddy caused by the passage of trains deposits this dust at a greater or less distance upon all sides, but it continues to be tramped upon and swept by air currents, and it is always being still finer

THE DEANE PUMPING ENGINE.



reduced, thanks mainly to the slate. As much more coal than sterile products pass through the galleries, the accumulated dust may be rich in volatile elements, and the greater the traffic the more dusty the gallery,

This finely divided state may give to the particles properties comparable to a combustible gas. The armorphous dusts, particularly those of vegetable origin, very fine and very dry and held in suspension in the air, may have the same properties and be susceptible of causing an explosion "by reason of the considerable value which must be attached to the proportion between the surface exposed to oxidation and the mass which undergoes this oxidation." (HATTON.) This value ought to be connected with the phenomonon of separation that we will study; the organic composition, and particularly azote and organic dust, ought to play a certain role in the explosions, and give the measure of the degree of explosibility of the mixture and the pyrometric effect.

"As to the speed of propogation of the flame, in mixture of pure air and dust, it is exceedingly feeble, With lycopodium it appears to be one decimetre per second; for coal, it does not even touch one centimetre. The real spreading is effected by mechanical action, which accompanies the phenomenon, rather than by its conductibility, radiating action and progressive deflagration properly so called." (HATTON.)

In this same connection we can mention the method of using pulverized coal in the Crampton furnace, and the experiments made in 1874, by M. Gueguen, upon the distillation of dust, or rather small grains, of coal, by allowing the particles of coal to fall through a vertical tube into the furnace, they being completely decomposed in this fall of about 1½ metres (5 ft.) We can reciprocally admit the complete distillation in a horizontal current moving with a velocity of 3 metres (10 ft.) per second.

3: *The quantity of oxygen contained in the dust.* This question is connected with the preceeding one, and is naturally developed with it. We have seen that the inflammability of coal dust is in direct proportion to the quantity of oxygen contained in it. The oxygen may proceed from the volatile matter or from the separation of the water of hygrometric origin. The first of these sources is alone variable, the second remains constant. According to the preceeding analysis, the proportion of oxygen varies from 1.261 for steam coal, to 6.030, for coking coal; but these figures while showing the difference have no value. But nevertheless, we can compare them with those given by M. de Marsilly, who figures the oxygen at 1.070 for poor coal and 5.450 for fat coal.

The quantity of hydrogen varies relatively very little; the ratio $\frac{O}{H}$ gives the measure of the hurtful influence of the dust. This ratio may go even to 3 in the fat coals, and descend below one in the meagre coals.

We then, in the same time, have the measure of the inflammability, but in no case can we admit the spontaneous combustion of the dust. The oxygen condensing on the surface of the grains of dust escapes analysis, and as the contained water would not be able to furnish this oxygen under the temperature at which the coal commences to distill, it is necessarily borrowed from the surrounding atmosphere.

TO BE CONTINUED.

The Deane Pumping Engine.]

We present herewith an illustration of a compound duplex pumping engine recently built for water works service by The Dean Steam Pumping Co., Holyoke, Mass.

This engine has 16-inch high pressure cylinders, 24-inch low pressure cylinders, 11-inch water plungers and 18-inch stroke. The position of the high pressure cylinders provides for expansion of the metal under varying temperatures. The connection of these cylinders to the larger ones admits of external stuffing boxes. The latter cylinders have controlling valves for adjusting the steam cushion. The steam connections allow steam to be instantly admitted to all the cylinders for increase of power when desired and as quickly returned to the ordinary expansive working at will. The valve moving mechanism is proportioned to give prompt admission and free exhaust, and adjustment for wear and varying requirements.

The water end of the engine is connected to the steam end by finished wrought-iron tie rods securely keyed in place. The piston rods are of steel, with a brass covering on the part entering the water. The packing rings, valve seats and bolts in the interior are of solid gun metal. The connections, cylinders and valves are designed to give a free passage for the water. By pass pipes between the suction and discharge pieces, for use in starting, are provided and ample air chambers as shown.

The engine described will discharge about one and one-half million gallons of water per day against 150 pounds pressure at ordinary speed.—ADV.

A NEW ITALIAN IRONCLAD.—Great preparations are being made at Venice for the launch there, on the 30th inst., of the new ironclad "Francesco Morosini" in the presence of the King and Queen and the Prince of Naples. People are flocking into Venice from all directions, and it is expected that the members of the Moorish Embassy will be present. The "Francesco Morosini" is a ship of the "Duilio" type, and differs but little from her, except in matters of detail and the introduction of the latest improvements. She is to carrry, apart from other artillery, four 106 ton guns. Her length is 100 metres, with a maximum breath of 19.80 metres, an immersion of 8.86 metres, and a displacement of 11,000 tons. She is to be propelled by twin screws, worked by duplicate engines of 10,000 horse-power, which it is calculated will give her a speed of 16 knots. Her supply of coal will be 850 tons. Francesco Morosini was a famous Venetian Admiral of the 17th century. He defended the island of Candia against the Turks for eighteen months, during which time he repulsed more than fifty assaults, but was finally obliged to capitulate.

A NEWLY-DISCOVERED METAL.—Norwegium is the name of a newly-discovered malleable metal of white color, with a tinge of brown. It presents, when pure, a metallic lustre, but on exposure to the atmosphere becomes coated with a thin film of oxide; its hardness is about that of copper, and its specific gravity is 9.4441. At 350° C. it melts. It was found while examining a piece of nickel ore from Kragere, Norway.

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A CORRESPONDENT has called into question the correctness of the directions for the "Reverse Blue Print Process," republished by this journal on Aug. 15 from the Providence *Journal*. He says he has tried it and obtains an ordinary "blue print." As this reverse process, giving blue lines on a white ground, has many advantages over the ordinary "blue print," we would ask any of our readers who have practically experimented with the new process, to give our readers the benefit of their experience, and correct the quoted account if it needs correction.

A PERSONAL application is made to the editors of this journal for the services of a man who can meet the requirements stated below; knowing of no one, just at this time, to recommend, we send the requisition afloat among our subscribers, in the hope that both parties may be benefited thereby.

The applicant must be well posted in the theory and practice of the construction of water works; be of pleasing address and capable of making contracts, obtaining franchises, attending lettings, etc., as well as actually superintending the building of works; in fact, be a good business man as well as a thorough engineer. Anyone who can satisfactorily fill the bill of particulars can find remunerative employment with a well known and reliable firm of water works builders.

Address "Water-works" care of this office.

A Proposed Thames Tunnel.

Engineering, of Aug. 14, describes a novel type of tunnel proposed by Messrs, Maynard and Cooke for crossing the Thames below London Bridge.

The general scheme is practically the sinking of a series of wrought-iron caissons by compressed air, and connecting them in such manner as to form a tunnel with its crown but 5 or 6 feet below the bed of the river.

The section would be elliptical with a total width of 62 feet and a roadway 38 feet wide and 20½ feet high, and side-walks of 8½ each. The sides extend below the tunnel proper so as to form a caisson with cutting edges all around a section, say 60 feet long, a shaft would communicate with the outer air, and as the caisson with 60 feet in length of the tunnel on top was sunk a temporary crib would be carried to the water surface. During the sinking bulkheads close the ends of the tunnel, and the finished section is shut off in like manner; when the connection is made between the completed work and the 60 feet section last sunk, the inner bulkheads are removed.

The tunnel itself would be constructed of an inner and outer plate iron shell and the space between filled with brick or concrete. The entire cost for the site proposed of a tunnel 1800 feet long is estimated at $1,250,000.

Bainbridge's Colliery Manager's Calculating Scale.

We have received from the inventor an ingenious calculator working upon the principle of the Slide Rule. It is intended to facilitate the working out of the "costs per ton," a statement made weekly in almost all collieries and mines.

The Calculator is practically a boxwood Slide Rule, about 2 feet long, but by a special arrangement the marking is on a scale four times as large as usual. The inventor claims the following as special features in the device:

1. It will divide a certain number of tons (or any other divisor) into any number of amounts of money, for the purpose of getting the cost per ton in pence, only one movement of the calculator being necessary.

2. The time taken in denoting the cost per ton is ONE FOURTH of that usually required in calculating the cost in the ordinary way.

3. The absolute accuracy of the Calculator is a point of great importance, and is also a means of avoiding the lost time which is frequently caused by a single error in the usual mode of calculating.

In colliery practice, the total out-put in tons being known and also the aggregate cost of each item for this tonnage, one adjustment of the scale allows the cost per ton per item to be read from the scale. But as this scale is adapted to English practice only, the amounts are in English money. The Calculator can also be used in obtaining the percentages when the cost per ton, in *pence*, is known. It is also claimed that the Calculator can be used for working out horse-power, or any question involving a number of divisors or multipliers.

Any further information must be obtained from the agents "The Hardy Pick Co.," Mining Tool Works, Sheffield, England.

The Glasgow, Mo., Bridge.

A newspaper paragraph some weeks ago stated that some changes of grade and alignments were being made on the Glasgow, Mo. Bridge of the Chicago and Alton R. R. To get at the exact state of the case we sent the paragraph to Gen. W. Sooy Smith, the engineer of the bridge, who answers as follows:

AUGUST 24, 1885.

EDITOR ENGINEERING NEWS:—In answer to your inquiry as to Glasgow Bridge I inclose a letter just received from K. F. Booth, Chief Engineer C. & A. R. R., from which you will learn that the change of grade and alignment referred to in the newspaper paragraph which you sent me, have no reference to the bridge, which is the best one yet built across the Missouri river.

Very Truly Yours,
WM. SOOY SMITH.

The following is Mr. Booth's letter:

CHICAGO & ALTON RAILROAD CO.,
CITY ENGINEER'S OFFICE,
CHICAGO, Aug. 17, 1885.

GEN. WM. SOOY SMITH:

Dear Sir: Mr. Bryson has handed me your letter to him of the 5th. inst., and requests me to answer it. We are changing the line and also the grade near the east approach of the Glasgow Bridge. We are also doing the same thing at several other points on the Kansas City division. These changes are being made for the more safe and economical operation of the railroad. It is over two years since we commenced work of this kind on the Kansas City division. We have been doing that kind of work on the Illinois lines for more than ten years, and are this year doing that kind of work at several points in Illinois. None of these works have any connection with the Glasgow Bridge.

Yours Truly,
K. F. BOOTH, Chf. Eng.

PERSONAL.

L. VON REIGENSTEIN, civil engineer and draughtsman died at New Orleans, on the 19th.

WALTER DE KANTZOW, resident engineer of the Cincinnati, New Orleans and Texas Pacific Road, died Aug, 20, at Cincinnati, O.

JOHN DUNN ESQ., Assistant to the President Illinois Ceneral R. R. was in New York this week.

GENERAL MANAGER ROBINSON, of the Mexican Central, will sever his connection with that company on the 1st of next month to accept an important position with the Atlantic and Pacific.

The Hon. D. J. MORREL, one of the most prominent iron and steel manufacturers of the country, and for years general manager of the Cambria Iron Works, of Wood, Morrell & Co., died at his residence, in Johnstown, Penn., aged 64 years.

The following promotions have been made in the U. S. geological survey: HENRY GANNETT, of Maine, from chief geographer to geologist, vice JOSEPH S. CURTIS: ALMON H. THOMPSON, of Kansas, from geographer to chief geographer: ROBERT S. WOODWARD, of Michigan, from astronomer to geographer,

MR. ASEL STORRS LYMAN, the inventor, died at the residence of Mr. Livingston Middleditch, his son-in-law, in Brooklyn, yesterday morning. Among his inventions were the fibre gun for disintergrating wood for paper pulp, and the multicharge gun. He was a native of Potsdam, N. Y., and was in his 71st year.

DAVID S. BABCOCK, vice-president of the New York, Providence and Boston Railroad, was killed at Stonington, on Aug. 24, while walking across the railroad track near the depot.

Captain Babcock was about 63 years of age and leaves a family. Besides being vice president of the road, he was general manager of the Providence and Stonington Railroad and president of the Providence and Stonington Steamship Company. He has been in the employ of the railroad company for many years. The President of the railroad, S. D. Babcock, is his uncle.

Mr. COURTLAND D. HOWELL died recently at his residence, 1806 De Lancey Place, Philadelphia, after a lingering illness of several months. Mr. Howell was a man of strong characteristics. In early life he was educated to the profession of civil engineering, which he pursued with marked ability. He was one of the engineers employed by the Pennsylvania Railroad in building that section of the road near Altoona, and was a contempoary of Edward Miller and Strickland Kneass. In later years he became connected with the Farmers and Mechanics' National Bank, of Philadelphia and during the war, when Jay Cooke & Co, negotiated the 5-20 loan, he handled almost the entire proceeds, which were deposited in that institution. He was 71 years of age.

CORRESPONDENCE.

The White House Whitewash.

HANNIBAL, MO., Aug. 22, 1885.

EDITOR ENGINEERING NEWS:—Some years ago there was published a receipe for making a whitewash said to be that used on the White House, Washington, some of the ingredients being "White Lime, Rice Flour and White Glue," and the mixture was boiled in making. I made and used the wash, some ten years ago, and found it very satisfactory. Can you give me the recipe again, or suggest where I may find it, if so you will greatly oblige.

Yours truly,
J. H. DECKER.

Why the English Cling to Old Weights and Measures.

SECOND PAPER.

Communicated to ENGINEERING NEWS.

Cold water doctrine is not acceptable, it would appear from the following observations of Sir Frederick Bramwell in the Institution of Civil Engineer's discussion.

"The author had placed before the members two comparative calculations, employed to ascertain the weight in tons and decimals of tons of the water contained in a given sized vessel. In consequence of the bulk of water representing the weight in French measures he was enabled to stop in his calculation on arriving at the cubic contents, and to say, 'The whole thing is done; there is the weight of the water; but if you do it in English measurements you have all these additional figures to use before you can get the weight of the water.' Assume for the moment the difference in the length of the two calculations existing, what did it prove as regarded the general question? Nothing whatever. To what did it apply? To fresh water at a particular temperature, and to nothing else. There was no other liquid on the face of the earth, from ether to mercury for which it would be true. It was not true for salt water, nor would it even do for fresh water at a different temperature. In any other case a multiplier must be used to get the weight, which would make the metric calculation as complex as the author's English example."

Before considering the valuable lessons which Americans may learn from this paragraph, some trifling defects in it should be averted to. It is inaccurate. In consequence of the author's assuming that the bulk of the water represented the weight in *English* measures, he was enabled to pause in his calculation on arriving at 70.162 + cubic feet as the contents, to move the decimal point and to say, "There is the weight of the water, 70 162 + ounces." By admitting this approximation he put the British example upon the same footing, as to obtaining weight from bulk, with the metric example. All these additional figures by the British method were required for the reduction of ounces and tons. In any other case, except the improbable one of having a multiplier showing tons per cubic foot, the metric calculation would have a similar advantage on the British method. Suppose ether or mercury or salt water or fresh water at a different temperature had been taken, and its heaviness was known in pounds per cubic foot, then besides multiplying it would have been necessary, in order to get tons, to reduce pounds to tons by calculation. On the contrary, with metric measures any required reduction could be made by changing the decimal point without additional figures, no matter whether grams, kilos or metric tons per cubic meter, decimeter or centimeter, or the specific gravity were given. Suppose again that instead of tons, the number of gallons or bushels, and liters or hekt liters contained in the same sized vessel had been required, in which case it would have made no difference in the result, whether measurement of water or of any other substance was contemplated. From the cubic contents in feet the required number of gallons could be obtained by multiplying by $\frac{1728}{277.274}$, of bushels by $\frac{1728}{2218.192}$, in British measure. From the cubic contents in meters the required number of hektoliters could be obtained by moving the decimal point one place, of liters three places, in metric measure.

It is a fact, (although the superior brevity of the metric calculation in the example used in the discussion did not depend upon this fact) that pure water at a particular temperature does furnish the basis for connecting bulk and weight in the metric system. The same is true of the principal non-metric weights and measures of this planet. In Russia the principal liquid measure, called the *vedro*, is the bulk of 30 *founles*, or Russian pounds, of water at standard temperature; the *krouchka*, or tenth of the vedro, of 3 fountes; and the *tchetverik*, dry measure, of 64 fountes. In Great Britain the bushel is the bulk of 80 pounds of water at a particular temperature; the peck, 20 pounds; gallon, 10 pounds; pint, 1¼ pounds; fluid ounce, ¼ pound. In Canada the same relations subsist. For Malacca, some capacity measures verified about two years ago by the British authorities were the *gantang*, containing 9 pounds of pure water at a particular temperature, the *chupah*, 2¼ pounds, and the *half chupah*, 1⅛ pounds. It has been proposed by Sir John Herschel and other misguided persons to alter our old standards so that water should be the basis of a connection between bulk and weight at the rate of 1,000 ounces to the cubic foot.

Sir Frederick Bramwell's depreciation of a fresh water relation of weight to bulk is flattering to our American vanity. The United States, unseduced by British and American examples, has steadily maintained the old wine gallon and corn gallon (and corn, be it observed, means old rye, barley and other grains which were known in England before America was discovered and maize introduced in England); and what Great Britain has to do to get rid of her insipid watery arrangements is to come back to those venerable standards from which she has been for a while straying away. Sir Frederick's influence ought to be strongly felt in urging her back into the fold.

That palladium of English liberty, the Great Charter extorted from King John in 1215, declared "There shall be one measure of wine and one of ale through our whole realm; and one measure of corn, that is to say, the London quarter." That this popular birthright should have been bartered away for an "imperial" measure of *water* at 16⅔ centigrade (or 62° Fahrenheit) shows the lukewarmness of British patriotism.

The 3,000 Feet Shaft on the Comstock Lode.

It should be a matter of pride to the people of the United States to know that within their boundaries is the deepest vertical shaft on the American continent, and the second deepest in the whole world. That is what is known as the Combination shaft, on the Comstock lode, at Virginia city, Nevada. It is being sunk by the Chollar, Potosi, Hale & Norcross and Savage Mining Companies; hence its name of the Combination shaft. This shaft has now reached a perpendicular depth of a little over 3,100 feet. There is only one deeper vertical shaft in the world—the Adalbert shaft of the silver-lead mines of Przibram, Bohemia, which at last accounts had reached a depth of 3,280 feet.

The attainment of that depth was made the occasion of a festival, which continued three days, and was still further honored by the striking off of commemorative medals of the value of a florin each. There is no record of the beginning of work on this mine at Przibram, although its written history goes back to 1527. Recently an elegant commemorative volume has been published in regard to this shaft, of which an English paper says:

"It is most interesting to those who have a taste for the actualities or the antiquities of mining industry."

Twenty years ago very few mining shafts in the world had reached a depth of 2,000 feet. The very deepest at that time was in a metalliferous mine in Hanover, which had been carried down 2,900 feet; but this was probably not a single perpendicular shaft.

Two vertical shafts near Gilly, in Belgium, are sunk to the depth of 2,847 feet. At this point they are connected by a drift, from which an exploring shaft or winze is sunk to a further depth of 666 feet, and from that again was put down a bore hole 49 feet in depth, making the total depth reached 3,562 feet. As the bore hole did not reach the seam of coal sought for, they returned and resumed operations at the 1,847 level.

In Europe it is thought worthy of particular note that there are vertical shafts of the following depths:

	Feet.
Eimkert's shaft of the Luganer Coal Mining Company, Saxony	2,653
Sampson shaft of the Oberhartz silver mine, near St. Andreasberg, Hanover	2,437
The hoisting shaft of the Rosebridge Collery, near Wigan, Lancashire, England	2,458
Shaft of the coal mines of St. Luke, near St. Chaumont, France	2,253
Amelia shaft, Shemnitz, Hungary	1,782
The No. 1 Camphausen shaft, near Fishbach, in the department of the Saarbruck Colleries, Prussia	1,650

Now, taking the mines of the Comstock for a distance of over a mile—from the Utah on the north to the Alto on the south—there is hardly a mine that is not down over 2,500 feet, and most of the shafts are deeper than those mentioned above; while the Union Consolidated shaft has a vertical depth of 2,900 feet, and the Yellow Jacket a depth of 3,030 feet.

In his closing argument before the Congressional Committee on Mines and Mining, in 1872, Adolph Sutro of the Sutro tunnel said:

"The deepest hole dug by man since the world has existed is only 2,700 feet deep, and it remains for the youngest nation on earth to contribute more to science and geology by giving opportunities of studying the formation of mineral veins at greater depth than has ever been accomplished by any other nation in the world."

Mr. Sutro was of the opinion that the completion of his tunnel would enable our leading mining companies to reach a vertical depth of 5,000 feet.

This great depth has never yet been attained except in a bore hole or artesian well. The deepest points to which the crust of the earth has ever been penetrated have been by means of such borings in quest of salt, coal, or water. A bore hole for salt at Probst Jesar, near Lubtheen, for the Government of Mecklenberg-Schwerin, is down 3,315 feet, the size of which bore is twelve inches at the top and three inches at the bottom. A bore hole was put down for the Prussian Government to the depth of 4,183 feet. But in these bore holes the United States leads the world, as there is one near St Louis, Mo., that is 5,500 feet in depth. Here on the Comstock, in the Union Consolidated mine, a depth of 3,300 feet has been attained, but not by means of a single vertical shaft. The vertical depth of the shaft is 2,900 feet; the remainder of the depth has been attained by means of winzes sunk from drifts. Several long drifts were run at this great depth without difficulty as regards ventilation or heat.

The Combination shaft is situated much further east (in which direction the lode dips) than any other on the Comstock. It is 3,000 feet east of the point where the great vein crops out on the side of Mount Davidson; 2,200 feet east of the old Chollar-Potosi shaft, 1,800 feet east of the old Hale & Norcross (or Fair) shaft, and 2,000 feet east of the Savage shaft. Thus, it will be seen it is far out to the front in the country toward which the vein is going. The shaft is sunk in a very hard rock (andesite), every foot of which requires to be blasted. The opening is about thirty feet in length by ten feet in width. In timbering up this is divided into four different compartments, some for the hoisting and some for the pumping machinery, thus presenting the appearance at the top of four small shafts set in a row. Over the shaft stand several large buildings, all filled with ponderous machinery.

The Sutro drain tunnel (nearly four miles in length) connects with the shaft at a depth of 1,600 feet, up to which point all the water encountered below is pumped. The shaft was sunk to the depth of 2,200 feet before more water was encountered than could be hoisted out in the "skips" with the dirt. At the 2,200 level two Cornish pumps, each with columns fifteen inches in diameter, were put in.

At the 2,400 level the same pumps were used. On this level a drift was run that connected with the old Hale & Norcross and Savage shafts, producing a good circulation of air both in the shaft and in the mines mentioned. At this point, on account of the inflow from the mines consequent upon connecting with them by means of the drift, they had more water than the Cornish pumps could handle, and introduced the hydraulic pumps, which pumps are run by the pressure of water from the surface through a pipe running down from the top of the shaft, whereas the Cornish pumps are run by huge steam engines.

By means of the hydraulic pumps they were enabled to sink the shaft to the 2,600 level, and extended the Cornish pumps to that point, where another set of hydraulic pumps was put in. They then sunk the shaft to the 2,800 level, when they ran another drift westward, and tapped the vein. The prospects at this depth in the Hale & Norcross, and Chollar mines were so encouraging that the management decided to sink the shaft to the depth of 3,000 feet. On reaching the 3,000 level, they ran a third drift through to the vein. The distance from the shaft to the east wall of the vein was found to be only 250 feet. At the depth of 3,000 feet they put in one of the pair of hydraulic pumps that is to be set up there. The second pump is now arriving from San Francisco, and as soon as the several parts are on the ground, it will be at once put in place alongside its fellow on the 3,000 level. This additional pump will increase the capacity from 600,000 to 700,000 gallons in twenty-four hours, or about forty-five miners' inches.

Owing to the excellent showing of ore obtained on the 3,000 level by the Hale & Norcross Company and to the continuation of the ore below that level (as shown by a winze sunk in the vein), the management determined this summer to sink the shaft to the vertical depth of 3,200 feet. It is now 3,120 feet deep, and it is safe to say that it will reach the depth of 3,200 feet early in September, when it will lack but eighty feet of being as deep as the shaft at Przibram was at the time of the great festival. Although the shaft is of great size—about thirty feet by ten feet before the timbers are put in—the workmen lower it at the rate of about three feet a day, in rock as hard as flint.

Standing at the 3,000 foot level and looking up a compartment of the shaft that is five by six feet in size, the little spot of daylight seen at the top appears to be about four inches square. At this great depth even a bit of rock of the size of a hickory nut falling from the top is dangerous. Before reaching the bottom it whistles like a rifle ball; indeed, its velocity is about the same as if it had been fired 1,000 yards from a cannon. If a man fell that distance there would only remain of his body and limbs fragments. Such is the care, however, of all employed about the shaft that accidents are of rare occurrence, and the men working at the bottom of the shaft feel quite secure.

The hydraulic pump now working at the 3,000 foot level of the shaft is the deepest in the world. In Europe the deepest is in a mine in the Hartz mountains, Germany, which is working at the depth of 2,700 feet. It is, however, a small pump, not half the size of the one in the Combination shaft. Although these pumps were first used in Europe, those in operation here are far superior in size, and in every other respect, to those of the Old World, several valuable improvements hav-

ing been made in them by the machinists of the Pacific coast.

The capacity of the two Cornish pumps, which lift the water from the 2,900 foot level to the Sutro drain tunnel (at the 1,600 level), is about 1,000,000 gallons in twenty-four hours, and the capacity of the present hydraulic pumps is 3,500,000 gallons in the same time. They are now daily pumping, with both hydraulic and Cornish pumps, about 4,000,000 gallons, but could pump at least 500,000 gallons more in twenty-four hours than they are now doing. The daily capacity with the hydraulic pump now coming, and which will be set up as mate to that now in operation at the 3,000 foot level, will be 5,200,000 gallons.

The water which feeds the pressure pipe of the three sets of hydraulic pumps is brought from near Lake Tahoe, in the Sierra Nevada mountains. This distance is about thirty miles, and the greater part of the way the water flows through iron pipes, which at one point cross a depression 1,720 feet in depth. The pressure pipe takes this water from a tank situated on the eastern slope of Mount Davidson, 3,500 feet west of the shaft. At the tank this pipe is twelve inches in diameter, but is only eight inches where it enters the top of the shaft. The tank whence the water is taken is 426 feet higher than the top of the shaft, therefore the vertical pressure upon the hydraulic pump at the 3,000 foot level is 3,426 feet. The pressure pipe is of ordinary galvanized iron where it receives the water at the tank, but gradually grows thicker and stronger, and at the 3,000 level, it is constructed of cast iron, and is 2½ inches in thickness. The pressure at this point is 1,500 pounds to the square inch.

In the early days of hydraulic mining in California the miners thought that with a vertical pressure of 300 feet they could almost tear the world to pieces, and not a man among them could have been made to believe that any pipe could be constructed that would withstand a vertical pressure of 1,000 feet; but we now see that a thickness of two and a half inches of cast iron will sustain a vertical pressure of over 3,400 feet.

There is only one pressure pipe for all the hydraulic pumps. This extends from the tank on the side of the mountain to the 3,000 foot level. It is tapped at the points where are situated the several sets of hydrauiic pumps. The water from the pressure pipe enters one part of the pump where it moves a piston back and forth, just as the piston of a steam engine is moved by steam. This water engine moves a pump which not only raises to the surface the water which has been used as driving power, but also a vast quantity of water from the shaft, all of which is forced up to the Sutro drain tunnel through what is called a return pipe. Each set of hydraulic pumps has its return pipe; therefore there are three return pipes—one from the 2,400, one from the 2,600, and another from the 3,000 level.

Some idea may be formed of the great size of these hydraulic engines when it is known that the stations excavated for them at the several levels where they are placed are 85 feet long, 28 feet wide, and 12 feet high. All this space is so filled with machinery that only sufficient room is left to allow of the workmen moving about. One of these stations would, on the surface, form a hall large enough for a ball room, and to those who are unacquainted with the skill of our miners it must seem wonderful that such great openings can be made and securely supported far down in the bowels of the earth; yet it is very effectually done. These great subterranean halls are supported by timbers 14 × 16 inches square set along the walls three feet apart, from center to center, and the caps or joints passing overhead are timbers of the same size. The timber used is mountain spruce. Not one of these huge stations has thus far cost one dollar for repairs. The station at the 2,400 level has been in use five years, that at the 2,600 three years, and the one at the 3,000 level eight months. Room for ventilation is left behind the timbers, and all are still sound. Timbers of the same kind are used in the shaft, and all are sound. The shaft has cost nothing for repairs. Being in hard andesite rock from top to bottom, the ground does not swell and crowd upon the timbers.

If it shall be thought advisable to go to a greater depth than 3,200 feet, a station of large size will be made on the east side of the present shaft, and in this station will be sunk a shaft of similar size. The reason why the work will be continued in this way is that in a single hoist of 3,200 feet the weight of a steel wire cable of that length is very great—so great that the loaded cage it bring up is a mere trifle in comparison. In this secondary shaft the hoisting apparatus and pumps will be run by means of compressed air. As it is very expensive to make compressed air by steam power, the pressure pipe will be tapped at the level of the Sutro tunnel and a stream of water taken out that will be used in running a turbine wheel of sufficient capacity to drive three air compressors. As there will be a vertical pressure upon the turbine at this depth of over 2,000 feet, a large stream of water will not be required. The water used in driving the wheel will flow out through the Sutro tunnel and give no trouble in the shaft.

By means of this great shaft and its powerful hydraulic and Cornish pumps the crust of the earth will probably yet be penetrated to far greater depth than in any other place in the world. It has been only a little over ten years since the work of sinking it was begun, whereas in the mines of the Old World they have been delving since "time thereof the memory of man runneth not to the contrary." The work on the Combination shaft has been by no means continuous. There have been long stoppages aside from those required at such times as they were engaged in running long drifts to the westward to tap the vein, and at times for many months, when the several companies interested in the shaft were engaged in prospecting the various levels it had opened up.

The work in the Combination shaft and the mines with which it is connected is not only of great interest to geologists, but also to all men of science, and there is afforded an opportunity for the observation of the increase of temperature as the crust of the earth is penetrated, and for many other interesting studies. It should also be of interest to the American people at large. Brande says:

"The subject of mines is one of the most important within the whole range of human knowledge. Their contents constitute the mainsprings of civilization, and the means employed to obtain them are to be ranked among the most extraordinary instances of human enterprise, patience and ingenuity."

There is a whole volume of truth in the forgoing sentence, particularly as regards the "enterprise, patience and ingenuity" required in mining at the great depth of 3,000 feet. As most of the heavy work is done and the ingenuity displayed at great depths in the bowels of the earth, few people see it or know anything about it. Not many persons can be induced to take a perpendicular plunge of 3,000 feet toward the center of the earth. Many will not even look into the top of a shaft of that depth without having a firm hold on some convenient and strong timber. Were the tiers of machinery, with all the huge pump columns, great pump rods, and other apparatus of the combination shaft, to be hoisted 3,000 feet in the air and there supported by means of an iron tower, it would be a sight that would astonish all beholders—would be a thing the sight of which would repay for his trip the visitor who might come from even the most remote corner of Europe.

DAN DE QUILLE.

—N. Y. *Sun*.

The Interoceanic Problem and Its Scientific Solution.*

BY ELMER L. CORTHELL, C. E.

By the advancement of science, and particularly through the means furnished by the science of *this* age it is possible to solve this problem in such a way, as to meet the demands of Commerce. The wants of man increase but his power to supply them increases also.

The ocean steamship, the locomotive, the telegraph and the ocean cable have accomplished wonders in bringing together the scattered countries of the earth, but this very accomplishment has brought greater demands upon science.

It should be a source of pride to the representatives of science, that it can furnish the means for overcoming an obstacle that turned back both Columbus and Cortez from their earnest search for the Pacific Countries.

The most serious obstacles to commerce have yielded to the science of man—all except this one that lies here in the center of the world—a narrow neck of land uniting two Continents and thus presenting an unbroken barrier, extending from the north nearly to the south pole.

In order to fully appreciate the necessity for Interoceanic communication information is needed on all subjects that affect humanity—Industry, Commerce, Politics and Religion. We must know what each country has for the demands of the others and by what routes the products of the world move. The more we investigate the more will it appear that free interchange is seriously hampered by the Interoceanic obstacle before us.

The Transcontinental Railroads have crossed the continent but they cannot afford to carry many bulky products.

Still less can the Panama Railroad do it on account of the great expense of trans-shipment. The cereals of the Pacific still go around Cape Horn on a voyage of 16,000 miles and other agricultural, and also manufactured products, traverse routes equally long and expensive. Our manufacturers, who turn out over five billion dollars worth every year,—exporting only *two per cent.*—cannot participate in the two billion dollars worth of trade of the Far Pacific Countries.

The goods cannot go Eastward for there they must compete with cheaper goods, going on shorter routes.

For four hundred years the attention of the world has been turned toward the American Isthmus. Governments, companies and individuals have examined, surveyed, planned and projected, but nothing has resulted. Our own statesmen from Jackson to Arthur have urged the importance of and necessity for this work.

The many routes examined have resolved themselves into three only, viz: Panama, Nicaragua and Tehuantepec.

Assuming it practicable to make the crossing at Tehuantepec, no one will question the assertion that it is much the most advantageous route. Its great commercial advantages are evident from two facts, *first*,—it lies nearer the axial line of productions, which may be assumed as passing through Hong Kong, San Francisco, New York and Liverpool. *Second*,—the nautical conditions are much more favorable than at the other locations, calms and baffling winds prevailing on either side of the Isthmus near its southern end, making it almost impossible for sailing vessels to navigate in those waters.

The true scientific method is that one which performs the work of transferring ships from one ocean to the other most promptly and most economically. This method is the *Ship Railway*.

This method is, in general, to lift the vessel from the water by well-known means and transport it 134 miles over the country and place it in the opposite ocean by the same means. The details embrace a lifting dock, with a system of hydraulic rams, so arranged as to hold up and perfectly distribute the weight of the vessel and a system of carriage supports conforming to the position of the rams and actuated by them, so as to be placed under the hull of the vessel.

The roadbed will be built of the best materials at hand, which the surveys show can be be found on the whole length of the Railway. The superstructure will be long steel ties on which will be laid heavy steel rails, weighing about 100 pounds per lineal yard. Powerful locomotives will haul the ships across the Isthmus. The locomotives built recently by the Baldwin Works are sufficiently powerful to do this work. These engines weigh when ready for service 102 net tons and their capacity is 3,600 *gross tons* on a level. Three of these will haul the maximum load of 5,650 tons at fifteen miles an hour on grades up to twenty feet to the mile.

The railway follows a succession of broad valleys, so that it is often necessary to make changes of direction to avoid the heavy excavations that would be required by employing the ship railway curves of twenty miles radius. These abrupt changes of direction are made by great floating turn-tables which float in segmental basins around a central pivot, though they do not rest on anything but the water, which is pumped into the surrounding basin from the turn-table to give it flotation.

The harbors, both on the Gulf and on the Pacific, are excellent and commodious and the entrances to them can be deepened with small expense.

The large number of practical experts who have carefully examined the plans have given unequivocal testimony to the entire practicability of the method and also to its economy.

This is not the only Ship Railway that has been projected. They have been designed for Honduras, Egypt and Nova Scotia. The time has passed when it is necessary to prove to practical men the feasibility of the Ship Rail-

*Abstract of an Address before the American Association for the Advancement of Science, at its Thirty-fifth Annual Meeting, Ann Arbor, Mich., August 26th, 1885.

way method, therefore the next important subject is taken up more in detail, viz: the *superior economy* of the ship railway over the ship canal, both in construction and operation.

The history of canal and rail transportation, going back to the earliest days of railways shows how quickly the latter took the lead in every respect, economy as well as despatch.

Experience and experiments both in this country and England are found in abundance to prove this.

If we compare ship canals and ship railways we find a greater difference in favor of the latter. The restricted channel in which the ship moves in a canal is the cause of the greater expense required to push the vessel through the water. The boat or ship practically creates a hill up which she is continually climbing; the faster she is urged through the water the steeper is the hill and the greater is the power required, which increases as the *cube* of the *velocities*.

In historical examination of the actual cost of moving freight by canal and by railroad shows that the latter is far in advance of the former in economy, and if the time lost on the canal is taken into account there is a still greater difference.

Some of the more important details of the comparison are here given. The constant improvements in railroad transportation have reduced the cost of *hauling* to 6-10 mill per ton per mile.

The load has increased from 20,000 pounds to 60,000 pounds in the last ten years, while the weight of cars has only increased 2,000 pounds. The increase of capacity in cars and power in locomotives, the introduction of steel rails and better system in operation, are the principal causes of the cheap and effective transportation of the present day.

Now, carry out these tendencies to their legitimate extent, as they will be in the Ship Railway; instead of 15 tons the average, or 30 tons the maximum, moving on *two* rails, put on 1,800 tons, moving on *six* rails, and then with great concentrated motive power, the freight will be hauled for *two tenths of a mill* per ton.

Then, compare speeds; *two miles* on barge canals is the economical and average speed, *one mile* per hour on ship canals is the customary speed and not over two miles on the Suez canals.

On railroads it is 15 to 20 miles, and on the Ship Railway 10 miles. The relative cost of transporting a ton of freight on a canal by steamer and in the free waterway of the ocean is as *six* to *one*. The total cost of *docking* and *hauling* from ocean to ocean on the Ship Railway will be 12 *cents*, but the cost of steaming through the Nicaragua will be 60 *cents*.

The immense cost of construction and maintenance of the canals, excavated, as the Panama is, below sea level, through a country of excessive rainfall; the long detour required for commerce; the instability of the governments and people through which they pass. These are some of the objections to the canals.

The *strategic* advantages of the Ship Railway are very important, Mexico and the United States together can protect the railway against any foreign powers. Our navy can hold the approaches to the Gulf; there is a capacious and protected harbor in the Coatcoalcos on the Gulf, and in Lake Superior on the Pacific, and the railroads leading into Mexico from the United States could quickly concentrate a large army at the Isthmus.

7,000,000 tons of freight are in sight for transportation over the railway in 1889. The railway can be built and equipped in four years time. $50,000,000 in cash will complete everything ready for business. The estimate in stock and bonds, allowing for all possible contingencies, is $75,000,000.

Even with only 4,000,000 tons the net profit would be 14½ per cent. The beneficial results cannot be overestimated.

Industry, commerce, society and religion, in fact in all his relations, will man be benefited.

The success of the projector of the Ship Railway in his other important works—iron clads during the war, the magnificent bridge at St. Louis, the Mississippi Jetties and other works, gives standing to this new work and leads to confidence in the ability of Mr. Eads to carry it through to a successful conclusion.

The address, printed in full, is illustrated by plates of the plans and by maps of the world and the Isthmus.

Chemical Analysis of the London Water Supply.

From the May report of Sir Francis Bolton, Official Water Examiner of London, the following chemical analysis of the water supplied to that city is taken:

CHEMICAL ANALYSIS, MAY, 1885, IN 100,000 PARTS.

COMPANY.	DATE.	Temperature Cent.	Solid Matter.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen Nitrates and Nitrites.	Total Nitrogen Combined.	Chlorine.	Hardness.
Thames	May 21st.	12.92	29.34	0.107	0.025	.....	0.184	0.209	1.8	17.1
Chelsea	..	13.3	24.09	0.121	0.027	.....	.149	.175	1.8	17.7
West Middlesex	..	13.5	24.90	.110	.021	.....	.153	.174	1.8	17.7
Southwark and Vauxhall	..	12.8	25.26	.100	.017	.....	.159	.176	1.8	18
Grand Junction	..	12.9	25.94	.104	.026	.....	.166	.190	1.9	18.3
Lambeth	..	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lee	..	13.	24.06	.088	.017	.....	.179	.196	1.8	17.1
New River	..	12.7	28.74	.141	.024	.....	.173	.198	2.	18.9
East London	..	.....	.....	.....	.....	.....	.....	.....	.....	.....
Deefwelly	..	.....	.....	.....	.....	.....	.....	.....	.....	.....
Kent	May 23rd.	13.5	31.07	.095	.008	.....	.375	.381	2.	25.7
Colne Valley	28th	.....	12.24	.042	.013	.....	.368	.381	1.8	9.9
Tottenham	28th	.....	35.94	.048	.017	.....	.....	.066	2.4	19.1
Birmingham	6th	9.4	25.60	.104	.036	.060	.003	.290	1.8	14.4
Glasgow	15th	7.5	2.90	.150	0.24	.....	.006	.030	0.7	1.0

1° hardness equals 1 pound in 100,000 parts. Samples from city distribution.

LITERATURE.

The American Engineering Register. Designed as a means of communication between Architects, Army and Bridge Engineers, Contractors, Civil and Consulting Engineers, Draughtsmen, Electrical Engineers, Experts, Gas and Geodetic Engineers, Geologists, Hydraulic Engineers, Hydrographers, Landscape, Marine, Mechanical, Mining, and Navy Engineers, Railroad Officials, Sanitary Engineers, Government, Country, City and Town Surveyors and Topographical Engineers and all those Merchants, Manufacturers, Bankers, Brokers, Attorneys, Solicitors, Agents and others who may desire to place themselves in direct communication with the foregoing Professions. Copyrighted 1885, by LEWIS M. HAUPT, A. M., C. E., Editor. ENGINEERING NEWS Publishing Co. Tribune Building, New York, 8vo. pp. 508 Price $2.00

The title of the *Register* is comprehensive and so well explains its purpose that little remains to be said by the reviewer. The editor has, with exceeding patience and much hard work, gathered a series of lists of names, professions and addresses that is as useful as it is interesting. We can appreciate the difficulties that beset his path in dealing with so nomadic a flock as American engineers, and it would simply be a miracle if the lists were faultless in stating the present position and location of the thousands of names contained therein. Besides the classified lists covered by the different branches enumerated in the title, the book contains an alphabetical list of railroads with the officials of each, and address at the time of publication. In the book are also included a number of useful formulæ, standard units of weights and measures, notes on the measuring of artisan's work, a very complete list of weights and specific gravities of substances, etc etc. Taking into consideration the exceedingly difficult nature of the task, the *Register* is well compiled and will doubtless serve a useful purpose to American engineers and to those who desire their address and services.

Main Drainage Works of the City of Boston, Mass., U. S. A. By ELIOT C. CLARKE, Principal Assistant Engineer in charge, Boston, 1885.

This work is the most interesting city document we have yet received, in the novel features introduced and important results accomplished. The main drainage works of Boston rank first in thoroughness of any, either projected or in operation, in American cities. The problem submitted to City Engineer Jos. P. Davis, his colleagues and his able assistants, was intricate and difficult; but by patient, intelligent work, from 1875 to 1883, the drainage of the city proper has been accomplished with results exceeding the most sanguine anticipations of its projectors.

Mr. E. C. Clarke, who was the Principal Assistant in charge from 1876 to the completion of the project, has in this final report given a complete through concise history of the operation from its inception, including very much of the valuable detail too often omitted in similar city documents.

Profuse and excellent illustrations mark this report; they give most satisfactory views of the scheme as a whole, contrasted with the original condition of affairs; the main and intercepting sewers in detail; the pumping stations with all its novel features; the outfall sewer with its tunnel under Dorchester Bay, shafts, etc., and finally the reservoir and appliances on Moon Island for discharge. All of this is fully described in the text, and the report concludes with the details of the engineering and construction, and a report upon the working of the new system. As an appendix, is given the record of tests of cements made in connection with this work and lately reprinted in ENGINEERING NEWS.

We can scarcely sufficiently commend the attention to the careful record of engineering detail connected with a great public work which has made this report possible; nor the liberal and proper spirit, on the part of the city authorities, which has put this record in such a handsome, permanent and available form.

We are advised however than the edition is limited, and few, if any copies are now to be had for free distribution. But an enclosure of $1.25 to the City Messenger of Boston will secure a copy, if orders are sent in at once; the proceeds of the copies thus disposed of accrue to the benefit of the city.

Transactions and Proceedings of the American Society of Civil Engineers, May, 1885.

CONTENTS.—"The Problem of the Submerged Weir," Clemens Herschel. "Structural Steel," Edward B. Dorsey. "Electrical Transmission from Niagara," Benjamin Rhodes, "Harbor Works at Copenhagan, Denmark," H. C. V. Moller. "Discussion on Leyee Theory Tested by Facts," J. A. Ockerson.

Report of Proceedings of the Fifth Annual Meeting of the American Water-Works Association, held at Boston, Mass., April 21, 22 and 23, 1885.

This is a detailed report of the proceedings of the last meeting, already reported for and published in abstract in this journal. It is an interesting document in its present form to any engineer connected with water-works construction, and contains much valuable information culled from the practice and experience of the members of the Association.

Modern Moulding and Pattern-Making. A practical treatise upon Pattern-Shop and Foundry Work. Embracing the moulding of Pulleys, Spur-gears, Worm-gears, Balance-wheels Stationary-engine and Locomotive Cylinders, Globe-valves, Tool-work, Mining Machinery, Screew Propellers, Pattern-Shop Machinery and the latest improvements in English and American Cupolas. Together with a large collection of Original and Carefully Selected Rules and Tables, for every-day use in the Drawing-office, Pattern-shop and Foundry. With 163 illustrations. By JOSEPH P. MULEIN, M. E. D. Van Nostrand, Publisher, New York, 1885, 8vo. 257 pp.

After the above very comprehensive title little remains for description, except to say that the author apparently carries out his promise of practically treating his subjects; the letter press and illustrations are good, and to those interested in the subject the book will no doubt be useful.

THE Lake Superior and Southwestern Railroad Company has filed articles. It will build from West Superior to Menominee, via St. Croix Falls. Capital stock is $4,000,000. The directors are: A. H. Hammond, W. V. Noad and C. L. Capplin, of West Superior, and G. W. Cumming and Joseph Kling, of St. Paul.

Exports of Hewn and Sawn Timber.

The following particulars are given in the report of Consul Cridland for Mobile:—

During the past year this growing branch of business, which is the most important of the pitch pine trade, has greatly increased in importance; and while it cannot be claimed that the business has been particularly remunerative to the shipper, owing to large stocks in Europe, yet the volume of business rapidly increased during the past year, and as Mobile woods have at last been thoroughly introduced into Europe, and seem to be much in favor, the port can safely look for an increasing trade with the United Kingdom and the Continent. Mobile is now one of the cheapest and most convenient ports in the United States, and, with the advantages offered by the new channel and a safe harbor, her timber trade will, it is said, at no distant day be second to none in the South. The timber is not surpassed in quality or manufacture by that shipped from other ports, and hewn timber of special average is difficult to procure at other points, while there is a never-ending supply, which in itself must recommend this port to buyers and shippers, and finally produce a desirable result.

As previously mentioned, the past season was not entirely satisfactory to shippers, as heavy stocks in Europe, held over from last season, and other causes, had their effect here as well as abroad; and the recent failures and suspensions, including the Bank of Mobile, also affected the timber trade as well as other branches of business. Notwithstanding the above facts, a good demand prevailed in this market for hewn and sawn timber, and producers obtained fair prices during the shipping season. The market opened at 10c. to 10½c. per cubic foot for hewn timber, and advanced until it reached 11½c. to 12c. in January. From then to May there was very little change, except that in some instances 12½c. was paid. In June it gradually declined, reaching 8c. to 8½c. in August. Sawn timber, which was in good demand, averaged during the season about 10c. to 11c. per cubic foot, on a basis of 40 cubic feet average. Owing to the uncertain condition of the timber markets it is almost impossible to predict the result for the season of 1884-85, but the present prospects are encouraging, and maybe there will be a change for the better, and what business is done with Europe will be more profitable to the shippers. The exports of 1884 are the largest on record, and show an increase of 120 per cent. over 1883, and over 100 per cent. over the year before, which was previous to 1884 the largest on record. The shipments of hewn timber show an increase of over 1,000,000 cubic feet, while sawn also shows an increase of over 1,000,000 cubic feet; but compared with last year the largest increase is in sawn timber, as the shipments are about 1,600,000 cubic feet against 484,000 cubic feet in 1883. The shipments in nearly every direction show a marked increase, especially to the United Kingdom of Great Britain and Ireland, as the shipments in that direction are about 1,700,000 cubic feet hewn and 1,100,000 cubic feet sawn, against 805,000 cubic feet hewn and 382,000 cubic feet sawn in 1883. The shipments to Germany and Holland show an increase in both hewn and sawn, but France exhibits a decrease in one and an increase in the other. About 100,000 cubic feet hewn have been shipped to Italy, against none the previous year. The shipments of timber in 1884, which are valued at 500,000 dollars are a good barometer of the past year's business, and show that probably in the future Mobile will be one of the leading timber ports in the Gulf, especially if the new channel in the bay is deepened to over 20 feet at low tide.

The manufacture and export of shingles has, during the past year, greatly improved in volume, which shows that Mobile-made shingles are not only of good quality, but low enough in price to compete successfully with those of other markets. A good freshet early in the season, by means of which a large supply of fine cypress was obtained from the swamps, enabled manufacturers to keep well stocked with timber during the entire season. Owing to the large number of shingles made during the past year, there was much competition between manufacturers, which caused prices to decline as the season advanced, and reach such a low figure that the profits were small. These low prices stimulated consumption, and caused not only a large and important business to be done with the interior of this and other Southern States, but many shipments to be made to new and important markets, as the railroads did all they could to foster the trade by giving low rates for shippers to fill all the orders received. Shipments of shingles were made from Mobile to Illinois, Tennessee, Ohio, Indiana, Wisconsin, Kentucky, Mississippi, Georgia, and Florida, also coastwise by sail to Boston, Texas and, other points. The demand for machine-made shingles is improving every year, and these, whenever used, give entire satisfaction, which is, no doubt, gratifying to the manufacturers in this district, who have during the past years gone to much expense and trouble in adding new and improved machines to their mills. The shipments foreign, which are principally to the West Indies, show a decrease of 142,958 shingles, while the shipments coastwise show an increase of 24,315 pieces. The falling off in shipments foreign is caused by the decrease in the trade with the West Indies, as in some of the islands the consumption of shingles is growing less, owing to the fact that iron is now used by many for roofing instead of shingles, which is a mistake for a hot climate. The difference in the summer temperature of the top rooms of a building covered with iron or shingles is that with the former the heat will be at least ten or fifteen degrees more than in the ones that are shingled.

Nearly all the shipments coastwise were to Boston or Texas, as 972,250 shingles were shipped to the former and 807,000 to the latter. —*London Architect.*

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page* 124).

The elevation at the point of a curve should be as great as at any other part, and in order to avoid an abrupt shock, the elevation is gradually run out on the tangent. Experience, which must be our best guide in this matter, shows that about 50 feet for each inch of elevation, gives very satisfactory results both for running on and running off the curve. Instead of elevating the tangent, and also to ease the approach to the curve, the curve can be gradually flattened or continuously compounded towards the point, and by keeping the elevation in accord with it, the curve and elevation can be run out together. The methods of doing this are clearly set forth in "Spiral Curves" by Searles, to which the reader is referred. Very excellent results are obtained by this practice, but it necessitates the curve being laid out by a transit and marked with permanent monuments, or else the trackmen will soon destroy the accuracy of the work.

It is not to be thought, however, that elevation will entirely take away the wear of the outside rail, for that rail still has to resist the tendency of a train to go straight ahead, that is, it must do the guiding. So at all speeds, the wheels will be found pressed against the outside rail, even in the center of a long freight train, where it might be expected to find the wheels drawn down against the inside rail, by considering them as links in a chain which the power at one end would tend to draw into a chord of the curve.

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TABLE NO. 7.—See Page 124.

Degree. Curve.	Miles per Hour. 10	15	20	25	30	35	40	45	50	60	Degree. Curve.
1	1/16	1/16	1/4	1/16	5/16	1/2	1 1/16	1 5/16	1 1/2	2 1/2	1
2	1/8	1/16	1/16	3/8	1 1/4	1 1/2	2 1/16	2 3/4	2 1/16	4 1/2	2
3	1/16	1/4	1/2	1 1/16	1 7/16	2 1/8	3 1/16	4 3/8	5 1/8	7 1/8	3
4	1/4	5/16	1 1/16	1 1/2	2 1/8	3	4 1/16	4 5/8	6 1/2	9 3/4	4
5	5/16	3/4	1 3/16	2 1/8	3 1/16	4 1/16	5 1/16	6 7/8	8 1/2	12 1/16	5
6	1/16	1/2	1 1/8	2 1/16	3 1/2	5	6 1/16	8 1/4	10 1/2		6
7	1/4	1 1/16	1 1/2	3	4 1/16	5 7/16	7 1/8	9 1/16	11 3/4		7
8	1/16	1 1/4	2 1/16	3 1/16	4 1/2	6 1/16	8 1/16	10 7/8			8
9	1/8	1 3/8	2 1/8	3 1/2	5 1/8	7 1/8	9 3/4	12 1/2			9
10	1/2	1 1/16	2 3/4	4 1/8	6 1/16	8 1/16	10 3/4				10
11	3/4	1 1/2	3	4 1/2	6 3/4	9 1/16	11 1/2				11
12	1/2	1 3/8	3 1/16	5 1/16	7 1/8	9 1/2	12 1/2				12
14	1/2	2 1/16	3 1/2	5 1/2	8 1/8	11 1/2					14
16	1 1/16	2 1/16	4 1/16	6 1/2	9 1/16						16
18	1 1/16	2 3/4	4 1/2	7 1/16	10 3/16						18
20	1 3/16	3 1/16	5 1/16	8 1/16	12						20

The turning over of the inside rail and cutting into the ties along the outside edge of the flange has formed a basis for the belief that wheels at low speeds or at speeds less than that for which the curve is elevated, press against the inside rail, but a moment's consideration of the principle stated above that the outside rail is the guiding power, will show that the wheel flanges press against the outer rail. If this does not suffice then it is only necessary to watch a few freight trains drag around a curve and note the wheels pressed against the upper rail, or else to examine the inside rail of a curve and to find the comparative absence of flange wear on the side of its head, unless it be a very sharp curve with contracted gauge.

As to position of both wheels of a truck, the leading wheel of course is the one which is guided, but this very action of turning it slews the track if running true so as to bring the rear wheel also bearing against the outside rail, though probably with diminished pressure. With engines the case is slightly different, for with their longer wheel base and greater weight they are not so easy to throw. At low speeds the trailing drivers probably run loose, that is, not pressing against either rail, and the tendency to press against the outside rail increases with the speed and degree of curvature.

Now this turning over is due to the fact that the lateral component of gravity is greater than its centrifugal force (see Fig. 115) so that the resultant instead of being vertical to the plane of the rails, makes an acute angle and is deflected toward the inside of the curve, bringing on that rail not only greater weight than its due (one half the load on the axle) but that increased weight with a lateral thrust. This lateral thrust is increased by the normal at the point of contact of the rail and wheel tread being directed outwards instead of vertically, due to the curved surface of the former and the coning of the latter. On the other hand when speed is greater than is allowed for in the super-elevation, the resultant passes obliquely through the outside rail and tends to turn it over. These effects are counterbalanced in England and Europe generally by inclining the rails inwardly so that the weight can be transmitted vertically through the web.

(TO BE CONTINUED.)

ENGINEERING NEWS Three months for One Dollar.

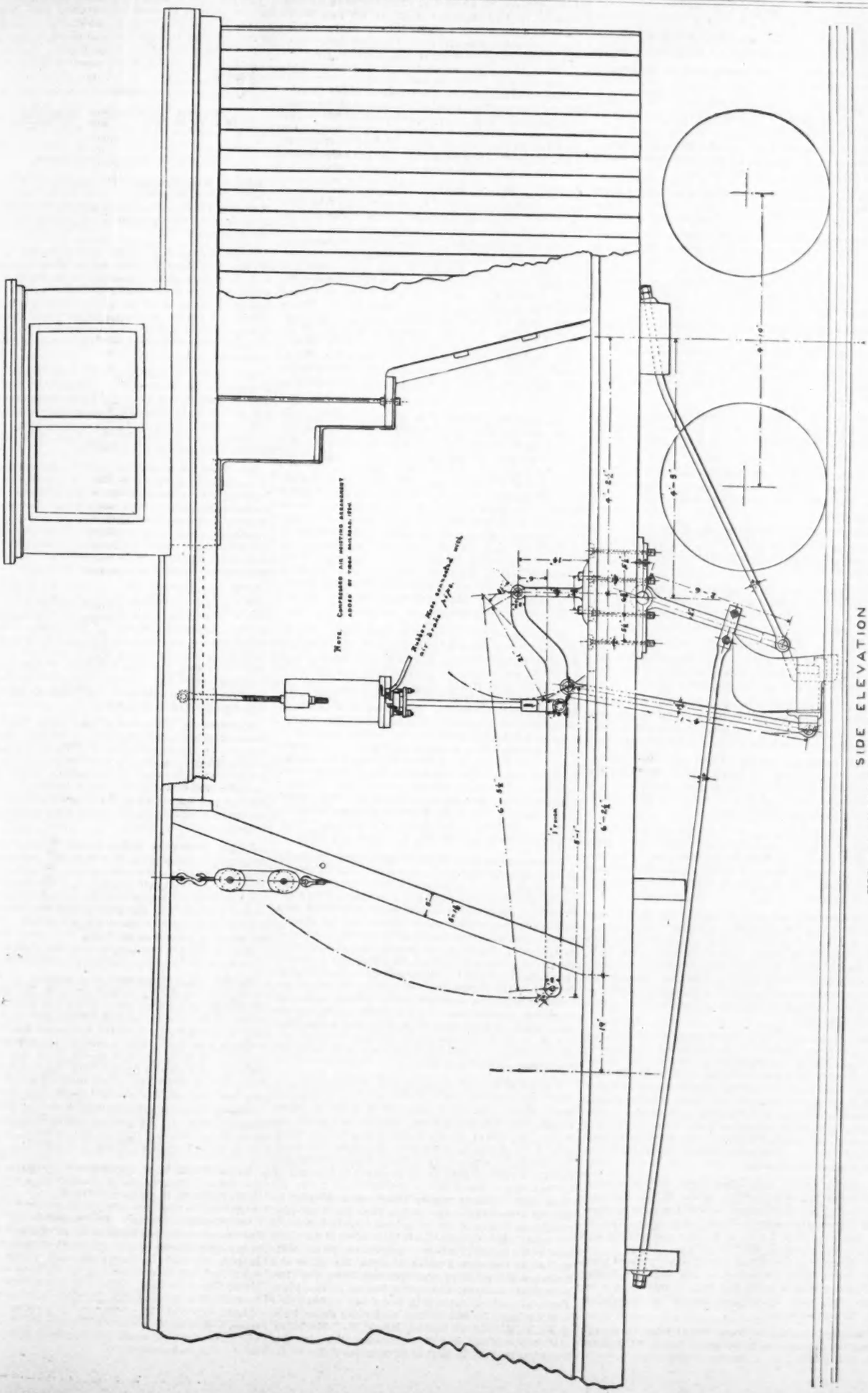

FIG. 118.—FLANGING CAR, N. Y., W. S. and B. R. R.†
SIDE ELEVATION

†Owing to the size and number of cuts belonging to this car, we introduce some of them ahead of the text so that they may be referred to when described.

WATER

THE Public Works Department of New York City, will receive bids till September 3rd for laying water mains.

GRAND Crossing, Ill., is considering the drainage of 12 square miles of territory adjoining it.

ATLANTA, Ga., is having a survey of its water-shed made so that plans for the new water-works can be intelligently discussed.

A FORCE of Italians have arrived at Middleboro, Mass. to work on the water-works. Work will commence in a few days, as soon as the pipe arrives.

THE Aqueduct Commissioners have authorized Clark & O'Brien, the contractors, to construct an additional shaft along the line of their work on the aqueduct.

WORK on the Marshfield, Wis., water-works, extension of 800 feet and reservoir is being pushed rapidly to completion.

S. B. RICHARDSON, the noted stock raiser of Massey's, in Kent county, Md., is building a windmill forty-two feet high for the purpose of pumping water.

CHATTANOOGA, Tenn., is to have new gas-works, with a holder of 80,000 cubic feet capacity; giving a total of 120,000 cubic feet with the holder now erected.

Bradstreet's, from the London reports estimates the annual value of the sewage of London at $8,000,000 at 8s. 9d. per head.

SPRINGFIELD, Mass., has under consideration a trial of the aeration system of the city water supply, as experimented with at Hoboken and Philahelphia on the Leed's system.

THE Fremont, Neb., water-works company, who have been investigating different systems, have reported in favor of works similar to those of Boone, Ia., which cost $22,000.

ABOUT four miles of water pipe have been placed underground in Fond du Lac, Wis., and a depth of 350 feet has been reached in sinking the first artesian well for the water-works.

Two hundred men employed in the water-works construction at Chippewa Falls, Wis., have struck for an advance of 25 cents per day in wages. The present wages are $1.25, and the men demand $1.50.

EBENSBURG, Pa., August 22nd. [THE vote on the question of increasing the indebtedness of the borough to secure a better supply of water resulted to day in the measure being adopted by a poll of 124 to 24.

WORK has commenced on pipe-laying for the water-works at Middleboro, Mass. A stand pipe 103 feet high is being erected and the pumping station is in process of erection. Water is hardly expected before Dec. 1st.

J. H. DECKER, Secretary of the American Water-Works Association advertises elsewhere this week the compilation of previous water-works reports of the Association. The attention of readers of this column is called to that advertisement.

THE village of Deposit, N. Y., has just put in a system of Water-Works; Gravity System, 160 feet head, main pipes 8" diameter, Distribution of 8, 6 and 4" 30 Hydrants, Length of main, 5,600 feet. Length distributed about 3 miles. W. B. Rider, of South Norwalk, Conn., Con. Engineer.

THE longest irrigation ditch in the far west is now being excavated in the northern portion of Wyoming, and will be, when it is completed, more than one hundred miles in length. The ditch is being put in by the Union Cattle Company, and it will extend from Stockade Beaver on Beaver Creek in Cook county, in a south easterly direction into and through a portion of the county lying adjacent to the Cheyenne river, a distance of 100 miles.

THE work on the new intercepting sewer on Alley street, at Lynn, Mass., still goes on at a very slow rate, the reason being that water cannot be kept out of the trench. The contractor, Conrad Juul, has set up a Hoadly engine, in place of the upright machine, and it does the work very nicely. The pump is kept running at short intervals all the time, but the ground containing many springs the water runs in as fast as it is pumped out. Another engine of the upright pattern arrived Monday, and has been placed on the gas house road for use in pumping.

CHICAGO, August 24th.—THE signal service here reports that heavy rains have fallen during the past thirty-six hours in Northern Illinois, Iowa and Indiana, and Eastward through the lower lake region. The fall in this city from 7 o'clock Sunday morning up to 3 o'clock this afternoon was 3.89 inches.

In the great storm of August 2nd, of the present year, there was a fall of 6.33 inches, so that thus far during the present month there has been a rainfall of more than ten inches, the greatest amount yet recorded in one month in Chicago.

THE Gardiner, Maine, Water Works, takes its supply from the Cobossecompte stream a feeder to the Kenebec; it is pumped by a duplex Blake pump, 12 by 18 inch cylinders, to a reservoir of two million gallons capacity, 112 feet above the dam. As the dam is 124 above tide, the pressure on the lower streets of Gardiner is that due about 220 feet. The distribution system includes about 12 miles of cast-iron pipe, from 4 to 12 inches diameter, furnished by the Gloucester Iron Works, with 50 hydrants, and about 50 gates. The works are being built by the Gardiner Water Co., the city paying a yearly rental for hydrants. J. J. Newman, of Providence, R. I., is the contractor, and the works are designed by and now being constructed under the supervision of M. M. Tidd, of Boston, Mass., as Chief Engineer. The works are to be finished this fall. The city contains 8,000 inhabitants.

ARTESIAN WELL IN MOSCOW.—This well was opened on the 1st of January, 1885. Boring was begun in 1865, but in 1871, the boring tool broke at the depth of 1,512 feet, and all efforts to extricate it were useless. In 1876 the work was abandoned. It the meantime, however, the water filled the bore to within forty feet of the surface, and as it was found that this height remained constant, a new plan was adopted. A gallery was excavated from the banks of the Jaonsa River to the well at a level low enough to permit the water to run into a reservoir at the other end. The gallery runs through limestone strata, is 1,400 feet long, and has a fall of 4½ feet. The water is pure, cold (8° R.), and flows abundantly, the daily supply being 770,500 gallons; this is nearly half the whole quantity of water supplied to the city of Moscow. This well ranks among the largest in Europe.

THE Hannibal Water Co. have but recently started their new two and one-half million pumping-engine, built by E. P. Allis & Co., of Milwaukee, Wis. It is a compound condensing fly-wheel (vertical) engine of the Reynolds Corliss type similar in design to the Milwaukee, Wis. (West Side) and the new St. Paul engine, and will develop a duty of 60,000,000 from a six pound evaporation, and a capacity of 2½ millions in 24 hours against a head of 235 feet at a plunger speed of 150 feet per minute. The principal dimensions are H. P Cylinder 23," S. P. Cylinder, 45," both 30" stroke, two single acting outside packed plunger pumps 17" × 30." Fly wheel 10 feet diameter. Total weight of machine about 100 tons. Thus far the machine works splendidly, and is showing an economy of nearly 70 % over the old H. P. direct acting engines.

HYDE PARK, Mass., 8 miles west of Boston, will be supplied by a system of driven wells, now being put down by Calvin Horton of Somerville, Mass. About 50 2-inch wells, from 25 to 38 feet deep, are connected to a single suction pipe. These wells are driven in a flat near the Neponset River: the supply expected is 500,000 gallons in 24 hours. The distribution will be by about 10 miles of cast-iron pipe from R. D. Wood & Co., from 4 to 14 inches diameter, and about 50 hydrants. The population to be supplied is about 8,000; the works are owned by the Hyde Park Co., the town paying hydrant rental. The pump is a Blake duplex compound of 1½ million gallons per 24 hours pumping against 220 feet head into a reservoir of 1½ million gallons capacity. Mr. M. M. Tidd, is engineer, and the works are built under his charge by John T. Langford, of Newton, Mass., and Perkins & Willcut, of Boston.

ROCHESTER, N. H., is about 10 miles north of Dover, N. H., with a population of about 5,000. The water supply is derived from a stream about 4 miles from the town. The supply is lead from this stream into a reservoir, of about 40 acres area and 28 feet deep, by a canal with controlling gates. There will be about 8 miles of distribution including the gravity main, and 50 hydrants. There are no pumps, the supply is by gravity with about 160 feet fall. The works are owned by the Rochester Water Co., the town paying hydrant rental. Mr. J. B. Farrington, of Conway, N. H., is the resident engineer, with Mr. M. M. Tidd as consulting engineer. Inman Bros., of New York are laying the pipe which is furnished by A. H. McNeal of Burlington, N. J.; the valves and hydrants come from the Coffin Valve Co., of Boston, and the dam is built by Mr. Shannahan, of Portland, Me.

WEYMOUTH TOWN 15 miles south of Boston, Mass., includes the four villages of Weymouth, North, East and South Weymouth. This corporation takes its water supply from Weymouth Great Pond 154 feet above sea level of an area of 300 acres, and a water-shed, exclusive of the pond, of 1,700 acres, The water for South Weymouth is pumped by a Blake duplex compound pump, 1½ million gallons in 24 hours to a height of 112 feet into a stand-pipe 40 feet by 75 feet high; the other three villages receive their water directly by gravity, except in the case of fire, when the stand-pipe supply can be turned on, or the pump applied direct to the main. The distribution is by 33 miles of cast-iron pipe from 6 inches to 20 inches in diameter, 278 hydrants and about the same number of gates; the gates and hydrants are made by the Chapman Valve Co. The population is 10,000; the works belong to the town, The total cost of the works was about $275,000; they were designed by and erected under the supervision of Mr. M. M. Tidd, of Boston, Mass.; W. C. McClallan, of Chicopee, Mass., was the contractor; the pipe was furnished by A. H. McNeal, of Burlington, N. J.

THE Borough of Danbury, Conn., is strengthening its two dams to the water-works, and have to build a new storage reservoir to cover over 70 acres of ground with an average depth of about 17 feet. The work will be let and commenced at once. W. B. Rider, Engineer, of South Norwalk, Conn., has charge of the entire work.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

Bids for R. R. Grading.—The engineer of the James Valley road is advertising for bids for the completion of grading between Jamestown, Dakota, and La Moure, the construction of bridges and culverts and the ironing of the road.

Sheffield, Ala., R. R.—It is reported that on the 20th the Directors of the Sheffield railroad closed a contract with New York parties represented by Mr. Harvey, a well known contractor, for the construction of the Sheffield road, work to be commenced in thirty days. A forfeit was put up, and the construction of the route within a year is thought to be assured. The meeting of the Directors was largely attended and much interest was manifested.

The Denver & New Orleans.—John Evans, Esq. President of the Denver & New Orleans road, with several other gentlemen interested in that enterprise, met August 18th, and prepared arrangements whereby there will be shortly consummated a reorganization of the Company and the immediate pushing of the work of constructing the road to completion.

Fort Worth & New Orleans R. R.—The contract for the construction of the Forth Worth and New Orleans Railroad to Corsicana, seventy-two miles, was signed on the 22nd, and work began on the road last Monday. The specifications for the new road are: Standard guage, first-class equipments in all departments; to be operated and owned for five years by the Fort Worth company building it. Men and teams are being gathered, and the work is to be pushed vigorously.

R. R. Contract Let.—The contract for grading the new Wisconsin Central extension, the Chicago, Minnesota & Wisconsin, from Schleisingerville to Chicago, was let to Harrison & Green, of Milwaukee. The firm will employ 500 men, and the grading will be done and the track laid so that trains will be running from St. Paul to Chicago over the Wisconsin Central line by December 1st. The country through which the new line is to run is so uniformly level that comparatively little grading will be necessary.

The Cresson, Clearfield & New York Short Line Railroad, thirty miles long, will be finished and cars running on it on November 1st. There are sixteen saw mills and twenty coal works brought into the market by the construction of this new line, besides a vast quantity of excellent timber which is of great value. The ore and coal are abundant. This line has cost at least $600,000, and will be one of the finest pieces of construction in the country.

Fargo, Moorhead & Northern.—Three of the incorporators of the Fargo, Moorhead and Northwestern were in the city of Fargo on the 21st. They report that New York parties have agreed to take the line by sections of twenty miles, as rapidly as completed. They expect to make both the preliminary and permanent survey, and secure the right of way, this fall. They do not ask either bonus or subscription to stock, but only encouragement in regard to traffic. The road is to run from Fargo to Red Lake Fall via Ada and Fertile.

Duluth Improvements.—A syndicate of Duluth capitalists, headed by A. J. Sawyer, A. M. Miller, L. Mendenhal and others, has purchased a large amount of land in the swamps on Rice's Point, and A. J. Sawyer, as representative of the syndicate, has signed a contract with the St. Paul & Duluth and Northern Pacific, by which a slip will be cut from the harbor, through the Northern Pacific docks, between Fifth and Sixth avenues west, and thence to Rice's Point. From this main slip smaller ones will be cut, thus giving the place two miles of additional dock room for elevators, manufactures, etc. Duluth has long needed more dock room to maintain her railroad and shipping interests. Work on the new slips will begin at once.

Grand Trunk R. R. Extension—It is reported that the Grand Trunk is about to construct a road from Battle Creek via Hastings and Freeport to Lowell, thus connecting its two lines and giving it a short cut from Grand Rapids to Chicago. The Grand Trunk railway has also projected an extension of its Midland system to Sault Ste. Marie, where connection is made with the Detroit, Mackinac & Marquette road, which is now completed to Humboldt, leaving but the short gap from Humboldt to Ashland. This will form a through line from Eastern Canada to the American Northwest south of Lake Superior. The difference in distance by this route, as against the present routes, by way of Chicago, will bring Montreal about four hundred miles nearer the Northwestern states.

A New Railroad in China.—BERLIN, Aug. 22nd.—The *National Gazette* says that China has contracted with a Manchester, Eng., firm for materials for the construction of a railway from Takou, at the mouth of the Hoen-Ho on the Yellow Sea, to Tong-Chow, on the Pei-Ho, an affluent of the Hoen-Ho, at a point about twenty-five miles east of Pekin. The railroad will be a most important work, and will be about 100 miles long, and will give Pekin a direct and easy communication with the Yellow Sea. The road is to be built and operated by the Manchester firm, with Chinese labor and capital. China is now engaged in raising in Europe a loan of 100,000,000 florins to be expended in internal improvements.

Strategic R. Rds.—"Russia is building a strategic railway to the Austrian frontier." You know what a strategic railway is, don't you? Buys its right of way from the farmers for an annual pass, then gets all their land condemned and takes up the passes, then gets a state grant of two or three counties for the directors, buys its iron on long time, and pays for its grading with construction bonds, then issues equipment bonds to pay for rolling stock, borrows all the money in the country on the mortgages, calls in everything outstanding and exchanges it for a deficit, changes its name from the "North and South Air-Line" to the "East and West Shore Line," divides the swag among the directors, and runs the road with the deficit. It may be new in Russia, but it's an old thing with us. Country's just full of stragetic railways.—*Brooklyn Eagle.*

Northwestern Extension.—Excitement is at fever-heat over the visit to Galena, on the 19th., of a large party of railroad magnates of the Chicago and Northwestern Company, including Albert Keep, President of the road, General Manager Marvin Hughitt, Chief Engineer Raymond, Land Commissioner Chas. M. Simmons, Superintendent Swineford, of the Galena and Madison Division, and several others of lesser importance. Manager Hughitt arrived by carriage having ridden over the proposed line of junction between Freeport and this city. It is understood at Galena that last winter's survey is approved, and the Chicago and Northwestern Company will at once close the gap between Chicago and Freeport, via New California and Morseville, as already projected. Mr. J. H. Cook, connected with the land department of the road, has orders to remain and complete at the earliest possible moment the purchase of the unsecured right of way.

Alabama Railroads.—The length of completed railway track now in operation in Alabama, including main-line and side-track, is 2,182 miles, of which 960 miles are laid with steel rails. One hundred and sixty-four engines are in use on the Alabama roads, together with 87 passenger cars, 27 baggage, mail and express cars and 2,695 freight cars. The total capital investment is $73,013,319, the actual cost of the roads and equipments being $63,699,690. The number of miles traveled by passenger trains during the past year was 1,520,512. During the same time freight trains ran 2,735,753. The 1,269,504 passengers carried traveled 56,976,957 miles, and their tickets cost them $1,510,073. The freight moved amounted to 2,654,454 tons, for which the roads charged $4,613,620. The roads paid interest on bonds to the amount of $1,818,604, and declared dividends amounting, all told, to only $130,000. It will be seen that the number of passengers carried about equals the population of the State.

In point of railroad mileage Alabama stands fifth among the Southern States, not counting Missouri and Kentucky in the list, being exceeded by Virginia, with 3,410 miles, and Texas with 6,478. Among all States of the Union she stands twenty-second in point of mileage. Last year Alabama completed a trifle over 96 miles of new road.

Where Railroads Can be Built with Some Show of Profit.—A study of the advance sheets of Poor's Railway Manual, for 1884, shows where railroads are the most plentiful, and where they are most needed. Grouping the States into New England, Middle, Southern, Western and Pacific, and taking each group's share of the 125,000 miles of railway in existence at the end of the year 1884, some interesting figures are obtained. New England has 6,306 miles of complete railway or one mile to every nine and one-eighth square miles of territory. The railway mileage of the Middle group amounts to 19,203 miles, or one mile of road to every seven and one-half miles of territory. The Southern States have 19,895 miles of road, or one mile to 23 square miles of territory, and the Western States have 70,232 miles of road, or one mile to every 21.1 miles of territory. The Pacific group is at the bottom of the list with 9,742 miles of road, or only one mile to 95.2 square miles of area. Taking individual States at the basis of comparison, Illinois stands first with 8,909 miles of road, Pennsylvania second with 7,546 miles, Iowa third with 7,510, New York fourth with 7,335, Ohio fifth with 7,276, Texas sixth with 6,198, Indiana seventh with 5,534, Michigan eighth with 5,223 and Missouri ninth with 4,709 miles. It will be seen from these figures that the future railway development of the country is likely to be confined chiefly to the three groups of States designated as the Southern, Western and Pacific.

Track Laying has begun on the Cloverport and Bennettsville railroad, Ky.

A Ship Railroad that will Develop New Brunswick and Prince Edward Island.—BANGOR, August 17th.—A ship railroad project of great interest is absorbing the attention of men away down east. The scheme is intended to revolutionize the coasting traffic of the maritime provinces and develop the resources of the north shore of New Brunswick and Prince Edward Island. The railway is designed to connect Cumberland basin, at the head of the Bay of Fundy, with Bay Verte, an arm of Cumberland strait, Gulf of St. Lawrence. The isthmus which it is to span lies between Westmoreland county, New Brunswick, and Cumberland county, Novia Scotia, and is the boundary between these two provinces.

The isthmus is only about a dozen miles wide, and if, as it is asserted, it is practicable to transport vessels over it, a saving of over 300 miles can be effected in the voyage from the north shore or Prince Edward Island to Boston or other United States ports. By the natural route vessels from the Gulf of St. Lawrence are obliged to make a circuit of Nova Scotia, which is a great obstacle, not only by reason of the distance, but on account of the dangers of navigation along its rocky coast.

Work has already been begun on the railway, and good progress is being made, the chief engineer being John Fowler, who constructed the underground railway in London, and is now engaged on the long bridge over the Firth of Forth. Lord Brabourne of England, is president of the company engaged in the work. A London syndicate has signed a contract to furnish the money required.

When that ship railway is completed it will, if successful, wipe out the free-trade party here. Lumber is so cheap now that the Penobscot mills are shutting down, produce is so plenty that the farmers growl, and fish so plenty and cheap that quotations are at bedrock. —Boston *Globe.*

Contracting.

A Dredge Lost, with all Hands.—The captain of the steamship Alexandria, which arrived at Beaufort, S. C., Aug. 23, reported the loss of the dredge Beaufort in a hurricane off the Bermuda Islands, August 8, with all hands probably numbering ten men. The Beaufort cleared from Savannah July 20, for Greenock, Scotland, in ballast. She was built on the Clyde and brought to this side to dredge for phosphate in Beaufort harbor, but was found to be unfit for the purpose, and had started back to her builders. She was one of the largest crafts of her kind in the world, and was valued at $150,000. She was provided with a propeller and masts. Her captain was a Nova Scotian, named Penny.

Bids.—The following bids to furnish and erect the iron roof framing for the public building at Pensacola, Fla., were opened at New York on Aug. 12: Post & McCord, New York, $13,990; King Iron Bridge Company, Cleveland, $9,152; Hough, Ketcham & Co. Indianapolis, $8,959 68; Snead & Co., Louisville, $9,005. The Indianapolis firm was awarded the contract. The building is nearly ready to receive the roof framing, which will be commenced some time next month.

The Louisville, Ky., Harbor Improvement.—Messrs. Gleason and Gosnell, the well-known contractors, expect to begin working on their canal and harbor improvement contract next week. The present stage of the water is the only reason why work was not commenced this week. Their contract calls for the taking out of between 155,000 and 165,000 yards of stone, requiring a force of 90 to 100 men. The greater part of the labor will be done by machinery, seven of the latest improved steam drills and fully half a dozen boilers being needed. A regular iron railway, with a steam locomotive, will be used to carry the stone taken out to the incline where it is intended that it shall be placed.

With the improved machinery the force employed will be able to do the labor of 300 or more men working by the old method. When fairly started from 500 to 600 yards of stone will be taken out daily. At this rate it will require over 300 working days to complete the work, which, owing to unseasonable weather, will be distributed over several years. The contractors do not expect to get more than ninety working days before winter sets in.

The removal of the stone is a separate contract from the dirt excavation work, which is to be done by a Cincinnati firm. The stone to be taken out underlies about fourteen acres of land. The work will be commenced just below the dam, and will run from the Kentucky chute to Roach's dirt excavations.

The Burlington & Northern Contracts.—DAVENPORT, Special Telegram, Aug. 19.—E. P. Reynolds, of the contracting firm of E. P. Reynolds & Co., has been awarded the contract, by the Chicago and Burlington system, for the construction of that part of the new line to St. Paul, lying south of the Wisconsin river. He states that D. C Shepard & Co., of St. Paul, have received the contract for that part of the line north of the Wisconsin river, with the exception of thirty miles at Winona, which is to be built by W. H. Shepard of Winona. One new track is to be built from Oregon on the Rock river, and from Fulton on the Mississippi north to St. Paul, making 360 miles in all. Mr. Reynolds said the work would be commenced immediately and pushed to completion in a year, the cost to be $10,000,000, and the name, the Chicago, Burlington & Northern. The Chicago, Burlington & Quincy now owns track to Fulton, Ills., and by filling up the gap between place and Savannah and extending the line there will be furnished a direct route to St. Paul.

Mr. Spofford, one of the Burlington & Northern contractors, has set a force of men at work at Fountain City and sublet the contract for grading through the city of Alma, work to commence at the latter point at once. Mr. Spofford's contract covers thirty-five miles, from Bluff Siding to Chippewa river.

Indianapolis Prices.—At a meeting of the Indianapolis City Council Aug. 17th, the committee on contracts reported in favor of awarding contracts as follows: To Fred Gaasberg, to grade first alley west of Arsenal avenue, from Washington street to Market street, at 18 cents per foot front on each side; to H. C. Roney, to curb with stone sidewalks of North street, from Pennsylvania to Delaware, at 37 cents; to J. L. Spaulding, to pave with brick sidewalks of Eigth street, from Central avenue to Wabash tracks, at 28½ cents; to Thomas Cummings, to build a stone walk on the north side of Pogue's run, from Tennessee street to the first alley east of Tennessee street—masonry $4.35, dry excavation 10 cents, wet excavation 35 cents, timber per cubic foot 13 cents; to Freany Brothers, to erect lamp posts at $21 each post, with fixtures complete. The committee recommended that these bidders be awarded the contracts. Adopted.

Lynn, Mass., Sewer Contracts.—A short time ago the city of Lynn called for proposals for building the eastern intercepting sewer. The contract for the tunnel section was awarded to James Hogan of Ashland, but was subsequently forfeited on account of his not filling the required bond. Mr. Hogan's reason for not accepting the contract was attributed to his having made so low a bid that it would prove a losing venture. Accordingly the city advertised for proposals for constructing the tunnel section. The committee on drainage held a meeting recently and opened the bids, but deferred awarding the contract until a future meeting. The bids submitted were as follows:

Trumbull & Cheney, Boston	$85,375.05
O'Connor & Co., Boston	85 379.40
J. H. Leavitt, Boston	86,095.45
Conrad Juul, Lynn	86,998.30
William H. Ward, Lowell	87,208.50
James Heath, Lynn	87,808.20
John H. Dawe, Somerville	89,667.50
Kittredge & Mead, Cambridge	136,427.50

Trumbull & Cheney of Boston present the lowest figures, and it is thought that that firm will secure the contract. The contract for the other section was previously awarded to Conrad Juul of Lynn, and there are those who favor awarding the tunnel contract to James Heath of Lynn, whose bid is but $2433 15 higher than the lowest on the list. It is stated in behalf of Mr. Heath that he stands ready to furnish the requisite bonds immediately, and would employ Lynn laborers, a matter which was considered of sufficient importance to cause the insertion of a clause in the order authorizing the building of the sewer stipulating that local laborers should be given the preference. Mr. Heath has resided in that city for forty years, and, with his personal reputation as a contractor at stake, it is argued that he would faithfully perform the work.

Standing off the Contractors.—The Montreal *Times* says editorially that it understands that not a few of the contractors who built the roadbed of the Canadian Pacific are still besieging the company's offices demanding payment. The road was built, the *Times* says, by the money of the contractors:

These men finished up the work and patiently waited for the improving fortunes of the company to recoup their outlay. But no sooner did fortune smile upon the company than it put an obstacle between the radiant dame and the contractors. After a stalwart effort to help the company and a most successful effort too, so soon as funds are available the contractors are met with humbugging and humiliation. Although the company's engineers alone—men of their own appointment—had charge of the progress of the work, still the ruse of over-measurement was devised, and the imperious Mr. Van Horne has decreed that the ill-used men who have put the great work through shall wait still further until a new batch of engineers go over the entire Lake Superior section, remeasure cuts, fills and masonry and report the results. The truth appears to be that this latest departure is a rotten piece of chicanery and humbug. The money obtained the other day is manifestly wanted to put through ill-advised schemes of railroad conquest, and to stop leaks that are draining the company of its meagre legitimate sources. The transparent dodge of remeasurement is worse than no excuse for keeping contractors out of their pay, who have served the company so well. Some of the contractors, we are informed, put up $250,000, and more of their private means to carry on the work, and now that the grand total is large, they are met with the most despicable of suspicions as a set off to their reasonable demands.

Australia.—The Victorian Government, has recently had under consideration the desirability of filling up the West Melbourne Swamp. This low ground consists of about 600 acres, and has so far been an obstacle to the extention of the Victorian metropolis westward. The Melbourne Harbor Trust is raising much more silt and earth than it can utilize, and is depositing the surplus in Hobson's Bay, where it is useless. It is estimated that the cost of filling up the swamp in question with stuff supplied by the Trust would be about $75,000, but, as the Trust would be willing to contribute a portion of that cost, equivalent to the sum now expended in depositing the silt in the bay, the net cost to the Victorian Government would be about $10,000, per annum.—*Engineering.*

Index to Periodical Literature.

Boiler Plates—*Experience in the Use of Thick Steel Boiler Plates.*—A paper by G. W. Parker, read before the Inst. of Nav. Architects. Describes experiments made in consequence of the bursting under hydraulic pressure of a well constructed boiler. The fractured plate was of Siemens—Martin steel, 1¼-inch thick. A sister boiler was tested and showed no signs of weakness. The methods of heating and bending the plates are described, with notes on the proper mode of procedure. An analysis of the plate, and results of trials in testing machine, are given. Reproduced from "Iron." *Van Nostrand's Engineering Magazine*, September 1885, p.p. 200 to 203.

Bridge.—*Reconstruction of the Pecq Bridges, France.*—Two double-track bridges built in 1846, each consisting of three timber arches 31.5 metres (103 ft.) span. As reconstructed they are iron lattice-girder deck bridges, the lattice-bars at an angle of 45°. There are two of these girders, 6.6 metres (21 ft. 6 ins.) apart, and 4.05 metres (13 ft. 3 ins.) deep; each divided into 8 panels. The longitudinal ties are carried on plate cross-girders supported by braces from the lower looms. The masonry piers had to be built up higher. The construction, false-work, and mode of operations are described and illustrated in detail. *Le Génie Civil.* August 1, 1885, p.p. 209 to 213.

Cement.—(*See* Portland Cement).

Electric Lighting.—*Efficiency and Duration of Incandescent Electric Lamps.*—Report of a special committee of the Franklin Institute. Gives the code of tests and describes the construction of the types experimented with. The tests and their results are fully described. Several diagrams and illustrations are given, and a voluminous set of tables. *Journal of the Franklin Institute.* September, 1885.

Ferry Transfer.—A car transfer at Portsmouth and the Isle of Wight, England, similar in principle to that at Portland, Ore., recently indexed. A timber jetty with a grade of 1 in 8 has a double track, a timber cradle on 20 wheels being used to make connection between the tracks on steamer and jetty; the cradle is operated by a pair of 60 H. P. winding engines. The side wheel steamer is 130 feet long, 26 feet beam, 150 N. H. P. and has a double track on open deck. Fully illustrated. *Engineering.* Aug. 7, 1885, p. p. 124 and 126, 127.

Locomotive.—*Compound Passenger Locomotive.*—London & Northwestern Ry. (England); standard gauge Webb's system. Outside high pressure cylinders drive trailing drivers, one inside low pressure cylinder drives forward drivers. Driving wheels 75 inch diameter; single pair leaders 45 inch. H. P. cylinders 14 inch by 24 inch. L. P. cylinder 30 inch by 24 inch. Steel boiler 50 inch diameter 11 feet 4½ inches long. Wheel base 18 feet 1 inch. Weight in working order 95,200 pounds. Tender, six wheels 45 inch diameter: base 12 feet 6 inches. 2160 gallons water, 11,200 pounds coal. Total length over engine and tender 44 feet 11 inches. Illustrated in detail. *Railroad Gazette.*—August 21, 1885, p. p. 529 to 532.

Metallurgy.—(*See* Steel.)

Portland Cement.—By Henry Faija, M. I. C. E. States that little is really known about this material, and points out frequent errors made in specifications as to the properties of the cement, and the tests to which it is to be subjected. It cannot be both heavy and fine. The principal properties of a cement are its soundness, its tensile strength, and its firmness, all of which are considered. Reproduced from "Iron." *Van Nostrand's Engineering Magazine.* September, 1885, p. p. 216 to 222.

Projectiles.—*Electrical Determination of the Velocity of Projectiles.*—Describes the various forms of apparatus introduced from time to time since the first in 1740: including the ballistic, vibratory and other types. The present method of determination by means of electrically connected screens through which the projectile passes is fully described. Illustrated. *Journal of the Franklin Institute.* August 1885 p. p. 134 to 146.

River.—*River Buffalo; Total Flow at the Town Dam, King Williams Town, Cape of Good Hope, from June 1880 to March 1883 compared with the Rainfall.* W. B. Tripp, M. I. C. E. Continuation of observations published in 1882. Describes the watershed, and the observations of rainfall, with notes on the flow, volume, etc. The observations are tabulated. *Min. Proc. Inst. C. E.*, Session 1884-85. Vol. lxxxi, part 3.

Steel.—*Metallurgy of Steel.*—A lecture by P. G. Salom. Describes in detail the operations under the crucible, Bessemer and open-hearth processes; and enters into the questions of the physical qualities, and chemical constitution of steel. Illustrated. *Journal of the Franklin Institute*, September, 1885, pp. 208 to 230.

Tunnel.—A high-level tunnel adapted for cases where long approaches are to be avoided; the crown may be within 4 feet of the river bed. It consists of iron frames placed at certain distances apart, the portion between being either of concrete or brick in cement. The sections of tunnel would be floated into position and sunk; excavation being carried on by compressed air. The tunnel and mode of operations are illustrated. *Engineering*, August 14, 1885, pp, 153 154.

Recent Patents.

Dredge.—*George M. O'Donnell, Pittsburg, Pa.*—A scoop extending across the width of the vessel is secured to the lower end of a vertically adjustable spar and supported by stays from the after-part of the boat. The dredge operates by the movement of the vessel. No. 324,479.

Electric Railway Controlling System.—*Charles A. Mayrhofer, Vienna, Austria, Hungary.*—The track is connected with an electric apparatus having a paper moved by clockwork, upon which marks are made by a pointer when trains pass over certain points. No. 324,476.

Interlocking Mechanism for Railway Switches.—*E. H. Tobey, Denver, Col.*—Consists of vertical and horizontal shafts connected by bevel gearing, and connected with the switch and signal rods by suitable locking-arms. The combination is operated by the ordinary switch levers. No. 324,614.

Railroad Gate.—*John J. Murray, Brooklyn, N. Y.*—A pivotted gate-arm operated by passing trains; the arm swings vertically. No. 324,780.

Railroad Signal.—*James R. Park, Lavergne, Tenn.*—Consists of a horizontal drum on which is rolled or unrolled a flag signal; and a lamp having a rotating casing; the casing and drum are geared to work simultaneously. No. 324,411.

Railway Telegraph.—*E. B. Ives, N. Y. City and C. W. Williams, Cave City, Ky.*—For telegraphing to and from trains in motion, the current being conveyed from the main-line conductor parallel with the track through the rails and wheels to a suitably fitted car. No. 324,381.

Safety Railway-Switch.—*E. H. Tobey, Denver, Col.*—There is no tongue rail, one of the ordinary track rails being pivotted at its far end and moving to connect with one or other set of switch rails; a combination of arms locks the switch. No. 324,613.

Market Report of Engineering Materials.

New York, August 27, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	1.9c.	@ 2.2c.
Tee	2.2	@ 2.4c.
Beams and channels	3.0c.	@
Tank	2.	@ 2.1c
Shell	2.4c.	@ 2.5c
Steel plates, Tank	2¾c.	@ 3c.
WROUGHT-IRON PIPE. PITTSBURGH.		
Butt welded, black ..... Discount	47½	
" " galvanized ..... "	37½	
Lap welded black ..... "	65c.	@
" Galvanized ..... "	47½	
Boiler tubes ..... "	60	@
RAILS.		
Steel (large lots at mill)	28.00	@ 29.00
Old rails	16.00	@ 16.50
Old rail steel	16.50	@ 17.00
R R. spikes	1.8	@ 1.9
R R. splice-plates	1.55	@ 1.7.
R R. Track Bolts Square Nuts	2.75	@ 3.00
Barb-wire fencing, galvanized	4¾c.	@ 5¼c
" painted	3¼c.	@ 4¼c.
Corrugated iron		
Nails		
Iron	2.25	
Steel	2.40.	

METALS.

COPPER.		
Lake Superior	11.	@ 11¼
Other Brands	10¾	@ 11¼
LEAD.		
Com. Domestic	4.12½	@ 4.15
Lead Pipe	.05¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
ZINC.		
Sheet	5.20	@ 5.40

BRICK.

(Cargoes afloat)		
Haverstraw ..... per M.	$5.62	@ 6.00
Fishkill		
Up-River	5.00	@ 5.50
Jerseys	4.50	@ 5.50
Long Island		
" pale	2.75	@ 3.25
FRONTS.		
Croton red	13.00	@ 14.00
" dark	13.00	@ 14.00
" brown	12.00	@ 13.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	65.00	@ 130.00
" American	85,00	@ 120.00
Fire brick	25.00	@ 40.00

CEMENT.

PORTLAND.		
Gibb's English 400 lbs, per bbl	2.75	@ 2.90
K. B. & S. " "	2.85	@ 3.00
J. B. White & Bros., Portland Cement	2.65	@ 3.00
do Keene's Superfine,	8.00	@ 10.00
do " Coarse,	5.00	@ 6.00
Roman "	2.75	@ 3.50
Largerdorfer German "	2.55	@ 2 80
Dyckerhoff, " "	2.90	@ 3.25
Stettiner " "	2.60	@ 2.65
Hanover " "	2.60	@ 2.65
Vorwohler, Lion "	2.90	@ 3.25
Alsen, " "	2.55	@ 2.60
Fievez "	2.40	@ 2.50
Saylor's American	2.15	@ 2.40
Windsor, Standard, Cable's Portland } U. S. C. Co.	1.00	@ 1.10
		1.15
	2.15	@ 2.40
ROSENDALE cements	90	@ 1.10

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	0.95	

Add 25c. to above figures for yard rates.

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90	@ 95
" " No. 2 "	0.75	@ 0.80
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " " "	0.75	@ 1.00
Brownstone, Portland, Ct. "	1.00	@ 1.30
" Belleville, N. J. "	0.75	@ 1.25
Granite, rough	0.60	@ 1.25
Common building stone per load	2.00	@ 3.00
Base stone, from 2¼ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00

SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@ 20.0
Choice "	55.00	@ 80.
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	20.00	@ 22.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2¼ × 4 to 4 × 6 in. "	.17	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00	@ 40.00
YELLOW PINE, Girders "	25.00	@ 30.00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75	@ 6.00
LATH, Cargo rate "	2.10	@ 2.25

PAINT.

Lead, white, American dry per lb	.04¾	@ .05
" " " in oil pure "	.05½	@ .05¾
English, B. B. in oil	.08½	@ .08¾
Red, American	.05½	@ .05¾
Litharge "	.05	@ .05¼
Venetian red, American "	.01	@ .01¼
Indian red "	.05	@ .10
Vermillion, American lead "	.11	@ .11½
Paris green "	.15	@ .19
Umber, Amer. raw and powdered per lb.	.01¼	@ .01½
Drop black, Amer.	.08	@ .12
" " "	.09	@ .11½
Chrome green	.05	@ .15
Oxide zinc, American	.03¾	@ .04
" French	.06¼	@ .06¾

The North Pennsylvania Railroad is to be double tracked from Philadelphia to Bethlehem. The rails of the best quality, weighing sixty-eight pounds to the yard, have been purchased for the sum of $38 per ton, and the work of putting down the additional track has already begun.